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See back of cover for [illegible]

CORRECTION

MONTHLY WEATHER REVIEW, April 1949, vol. 77, p. 10[illegible]: In Figure 3 ordinate scale should be labeled in intervals of 100 instead of 50, covering the range from 1000 to 100 mb.

MONTHLY WEATHER REVIEW

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OBJECTIVE TEMPERATURE ESTIMATES FROM MEAN CIRCULATION PATTERNS [1]

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ABSTRACT

Two methods are developed for translating monthly mean circulation patterns into the accompanying surface temperature anomalies. Using a system of graphical correlation, temperature anomalies are deduced objectively from the curvature of isobars, pressure departure from normal, and air parcel trajectory on monthly mean 10,000-ft., or 700-mb. charts. The scheme is simplified by using the anomalies of flow and pressure as parameters. The results are extended for use on 5-day mean 700-mb. charts and further possibilities for improving the objective technique are considered.

INTRODUCTION

The preparation of long-range forecasts at the U. S. Weather Bureau involves first the construction of prognostic mean pressure and height charts and secondly the interpretation of these charts in terms of temperature and precipitation anomalies. In predicting circulation patterns, all available information of past behavior, including the weather associated with the observed circulation patterns, is considered. The second step of the forecast procedure has, in the past, been accomplished chiefly by a qualitative appraisal of the flow patterns.

The ability of forecasters to translate circulation prognoses into anomaly forecasts was investigated by Norton, Brier, and Allen [1]. In their experiment 3 experienced long-range forecasters were furnished observed sea level and 10,000-ft. pressure patterns and charts of weight between these levels, and were asked to draw the concomitant temperature and precipitation anomalies. It was found that a sizable portion of forecasting errors are apparently made subsequent to the completion of the prognostic pressure maps (that is, in the interpretation of the circulation patterns). In addition, the results obtained by different forecasters when interpreting flow patterns varied sufficiently that the need for an objective technique was clearly indicated. The hoped-for objectivity would have the effect of standardizing the interpretive processes and would lead to greater facility in applying and teaching the methods of extended forecasting.

It is recognized at the outset that there are two principal attacks to the problem of making better long-range forecasts. The difference lies in the order of operations: Whether the first attempts are for the improvement of the circulation prognosis or of the technique of interpreting the forecast. Much work has already been done on the former fundamental research problem with the expectancy that advances along these lines would be reflected in the anomaly forecasts. It is the present aim to develop the interpretive processes by a combined synoptic-statistical approach as was employed by Klein [2] in relating precipitation to upper level flow patterns.

Aside from the obvious practical advantages, it is clear that such an extensive empirical attack should cast a great deal of light on our fundamental knowledge of synoptic climatology.

PROCEDURE

In planning the work it was decided to divide the United States into broad geographical areas in which climatological influences are assumed to be uniform. These are shown in figure 1. These areas were chosen on the basis of experience gained by Namias and Clapp [3] and Smith [4]. Three cities were selected in each major subdivision by virtue of length of climatological record, and each of 4 researchers [2] was assigned one or more areas for study.

[1] A preliminary report on this subject was delivered at the annual meeting of the American Meteorological Society in Washington, D. C., on April 20, 1948, by Philip F. Clapp, Extended Forecast Section.

[2] J. F. Andrews, H. F. Hawkins, D. E. Martin, and K. E. Smith.

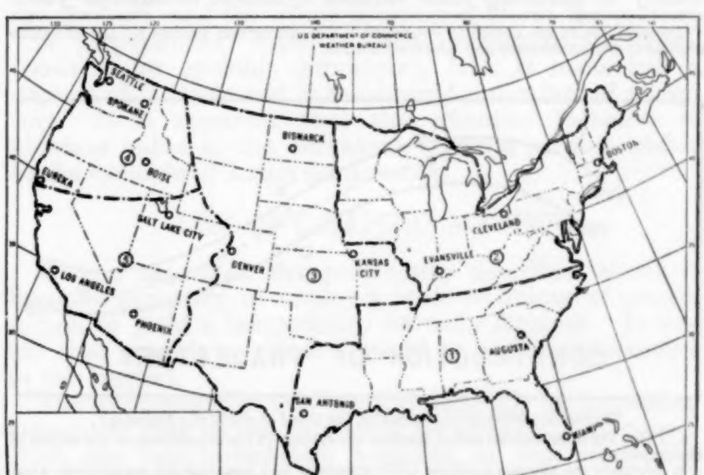

FIGURE 1.—Division of the United States into broad geographical zones of approximate climatic homogeneity for investigation of objective temperature forecasting techniques.

Upper level maps were used in preference to sea level maps because of their lesser complexity and the fact that they represent the primary consideration in our extended forecasting procedures. In considering the available data it was decided to make use of a 15-year historical series of mean monthly 10,000-ft. charts which had previously been prepared at the Extended Forecast Section. The decision to use these monthly data arose from the fact that 5-day means were available for only 6 years. Moreover, results obtained from this material would be directly applicable in the routine preparation of experimental mean monthly forecasts. Also it was believed that any method derived in this way could be adapted to usage in 5-day forecasting.

Monthly mean 10,000-ft. charts were constructed for the period from 1932 onward.[3] The first 13 years of data (from 1932 to 1945) were used in the investigational phases of the research problem. The last 2 years (1946 and 1947) were reserved for testing purposes

SELECTION OF PARAMETERS

On the basis of the experience of trained forecasters, and of theoretical as well as empirical studies, certain parameters were chosen. The first variable suggested as influencing the temperature field was the source region of the air expected at a given station. Air flowing from the north is generally associated with temperatures below normal, whereas above normal temperatures tend to result from southerly flow. Of course, topographical and geographical features would be expected to alter this simple relationship.

It is assumed that monthly mean 10,000-ft. charts are a good representation of the average stream flow during the month. A geostrophic wind computed from these charts should therefore approximate the resultant monthly wind velocity.

The mean trajectory of air parcels arriving at a station is assumed to coincide with the isobar through the station. The point of origin (see figure 2) is located by following the isobar upstream an arbitrary distance inversely proportional to the average gradient along the trajectory and depending on the season. For convenience in the computations, the length of the trajectory was determined as the travel distance at geostrophic speed for a period of 48 hours (except in June, July, and August, for which 72 hours was chosen as the time interval). It must be stressed that the time unit has no meaning other than utility in assuring that various synoptic situations yield

[3] 700-mb. charts are currently employed. The conversion process for the objective method is straightforward and relatively simple.

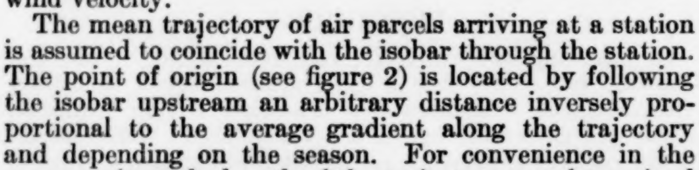

FIGURE 2.—Method of computing the point of origin of a trajectory:
a. Draw the intermediate isobar through the station (A) as an estimate of the course of the trajectory.
b. Measure the average gradient (BC) upstream and compute the geostrophic wind speed.
c. Proceed upstream along the trajectory a distance AD equivalent to the 48-hour travel of a parcel moving at the geostrophic wind speed. (Note: 72-hour travel is used in June, July, and August.)

a scattering of the points of origin while keeping these origins within the half-wave-length of the pressure system.

Trajectories were constructed in this manner for each station for each month. For Bismarck, for example, the points of origin were plotted on a North American base map along with the corresponding monthly mean surface temperature departure from normal at Bismarck. This geographical distribution of temperature anomalies was delineated according to the anomaly classes used in forecasting: much above and much below normal, each theoretically expected to occur ⅛ of the time; and above, near, and below normal, each expected ¼ of the time. The winter trajectory chart for Bismarck is shown in figure 3 and demonstrates the variability of temperature anomaly at that station according to the geographical distribution of the source of the trajectory.

When the trajectories were computed the winter data (December, January, and February) and the summer data (June, July, and August) were found to be sufficiently homogeneous to allow grouping on a seasonal basis. The spring and fall months, however, showed so much variability in wind speed and direction that they were treated individually by months.

It has been found (Namias [5]) that above normal pressure aloft and anticyclonic curvature of the isobars are associated with above normal temperature due to subsidence, and solar heating with clear skies. Cyclonically curved isobars and below normal pressures are usually related to convergence, cloudiness, precipitation, and a lack of solar radiation, leading to negative temperature anomalies at the surface. It was therefore decided to test the influence curvature and pressure departure from normal exert on the surface temperature.

The departures from normal of the 10,000-ft. pressures were obtained at 5-degree intersections of latitude and longitude for the mean monthly charts of the period studied. The 10,000-ft. monthly mean pressure departure from normal at each of the 15 originally chosen stations was correlated with the simultaneous monthly surface temperature anomaly at the same place. In addition,

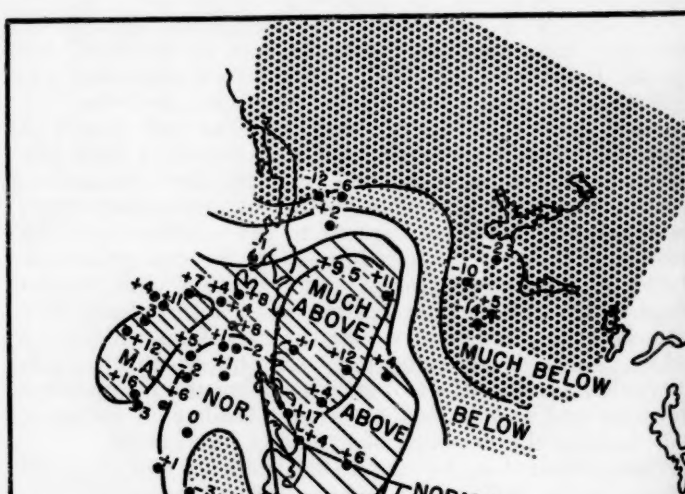

FIGURE 3.—Monthly mean temperature anomalies expected at Bismarck in winter according to the geographical location of the source of the 48-hour trajectory.

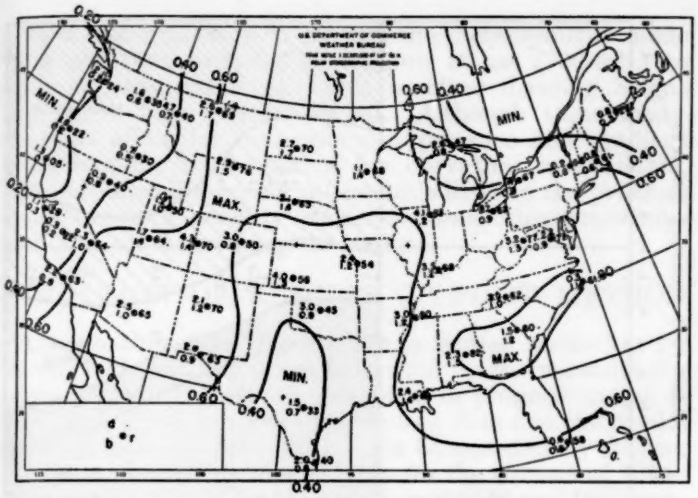

FIGURE 4.—Geographical distribution of correlation coefficients between surface temperature and 10,000-ft. pressure departure from normal for winter; upper left-hand figure at each station is "a" and lower left figure is "b" in the regression equation: $T=a+bP$; right-hand figure is the coefficient of correlation.

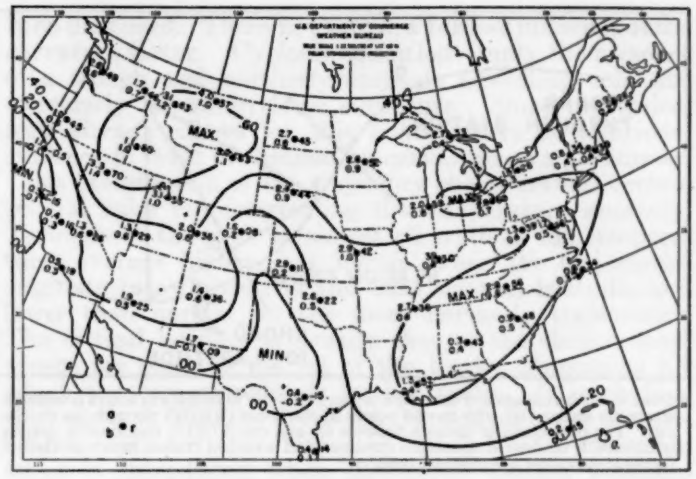

FIGURE 6.—Geographical distribution of correlation coefficients between surface temperature and 10,000-ft. pressure departure from normal for summer.

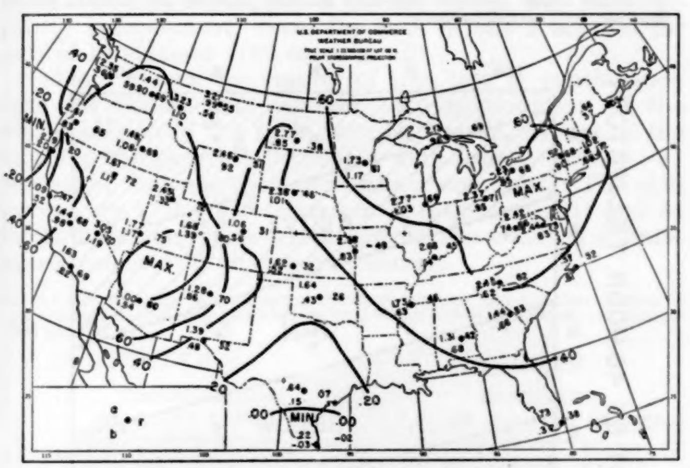

FIGURE 5.—Geographical distribution of correlation coefficients between surface temperature and 10,000-ft. pressure departure from normal for spring.

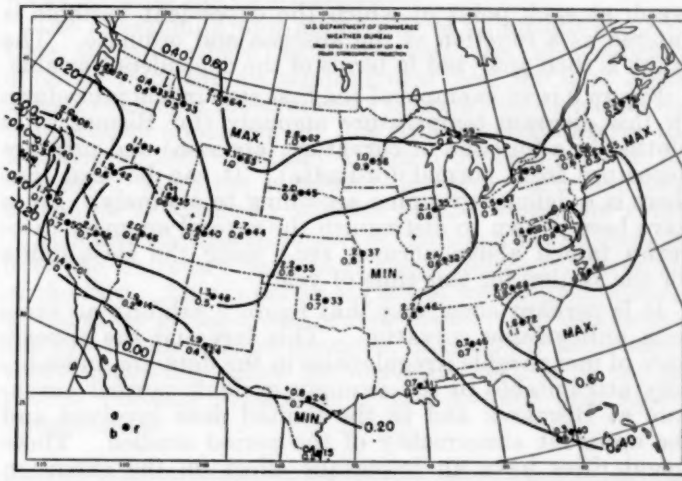

FIGURE 7.—Geographical distribution of correlation coefficients between surface temperature and 10,000-ft. pressure departure from normal for fall.

regression coefficients were also computed for these and other stations in each region. These coefficients of correlation and regression separated by seasons, were plotted on a map of the United States to discover the nature of their geographical distribution. (See figs. 4 through 7.) Isolines were drawn for the values of the correlation coefficient and areas of maximum and minimum correlation were marked.

In general, the correlations are good, the highest values being found in winter and spring and the lowest during the summer. The correlations inland are generally higher than those at coastal points, suggesting the existence of another important parameter along the coasts, perhaps surface wind direction.

At some of the stations where these correlation coefficients are lowest it was found that the curvature of the isobar is significant in determining the temperature anomaly. Usually, however, there is a pronounced relationship between curvature and pressure anomaly. As a result, curvature does not contribute markedly to the temperature anomaly after the effect of pressure departure from normal has been considered.

The actual measurement of curvature was neither as simple nor as direct as the measurement of the 2 parameters previously considered. Instead it was decided to determine a quantity analogous to the difference between the radius of a circle and the apothem of an inscribed polygon. In figure 8 the isobar QBHC passes through station H. The chord BC is constructed in such a way that its length is 10° of latitude, its end points are on the arc (isobar), and the chord is centered about the station. The perpendicular distance from the arc to the chord (positive for cyclonic curvature), HD, is measured in degrees of latitude and is the desired indication of curvature. It is apparent that this quantity increases in absolute value as the curvature becomes greater, either in the cyclonic or anticyclonic sense.

USE OF GRAPHIC METHOD

Having measured the parameters described above it becomes necessary to employ a facile technique of combination to yield a temperature anomaly forecast. It was felt that graphic correlation would be highly satisfactory in this respect.

The application of this method demands an increasing amount of data as the number of parameters is increased. With the few parameters involved in this study the

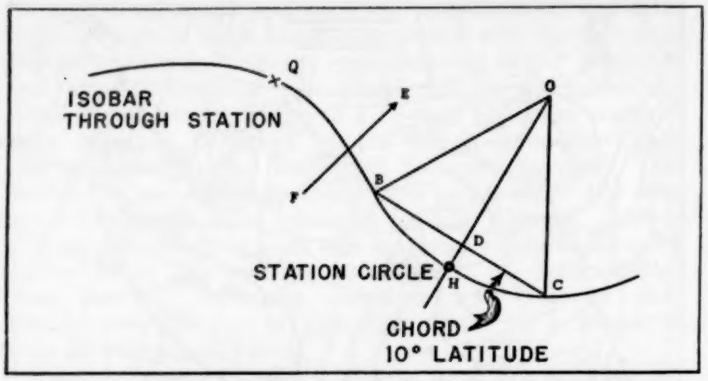

FIGURE 8.—Determination of curvature: a chord (BC) 10° of latitude in length is centered about the station (H) with its end points on the isobar (QBHC) through the station (H). The perpendicular distance between arc and chord (HD), measured in degrees of latitude, is the desired measure of curvature and is termed "radius minus apothem." Cyclonic curvature is considered positive.

utilization of the method is relatively simple. First, two of the variables are designated as coordinates of a graph at each point of which the dependent variable is entered as a function of the abscissa and ordinate. The graph is then analyzed in terms of the dependent variable.

Figure 9 is an example of the first step in the procedure. In this diagram temperature anomaly (for Bismarck) is plotted as a function of curvature (abscissa) and pressure departure from normal (ordinate). It can be seen that there is a definite grouping according to anomaly. Lines have been drawn to distinguish the several anomaly categories (much above normal, etc.) using the class limits for the station for this time of year.

It is perhaps surprising that figure 9 exhibits no cases with anticyclonic curvature. This fact and the appearance of inexplicable irregularities in the data are undoubtedly attributable to the strongly cyclonic normal curvature at Bismarck and to the limited data involved and the apparent abnormality of the period studied. These singularities have an important effect on the extension of the method to 5-day mean situations.

The next step of the graphic technique consists of obtaining a second estimate of the surface temperature anomaly from the location of the source of the trajectory. This is accomplished by the use of the type of chart shown in figure 3. A new graph is then derived using the curvature-departure-from-normal estimate of temperature as abscissa and the trajectory computation as ordinate. This new graph is analyzed in terms of observed temperature anomaly. For example, figure 10 shows this final graph for use in obtaining surface temperature anomalies for Bismarck. The value of the abscissa of this graph is derived from figure 9 and of the ordinate, from figure 3.

A set of graphs for each of the 15 stations investigated was prepared.

OPERATIONAL USE OF OBJECTIVE METHOD

Given a monthly mean circulation pattern and the set of graphs described above it becomes possible to estimate the surface temperature anomalies for a sufficient network of points to determine the temperature pattern for the United States as a whole. Since monthly data alone have been used in developing the method, however, it is necessary to apply corrective factors if results are desired with the use of 5-day material.

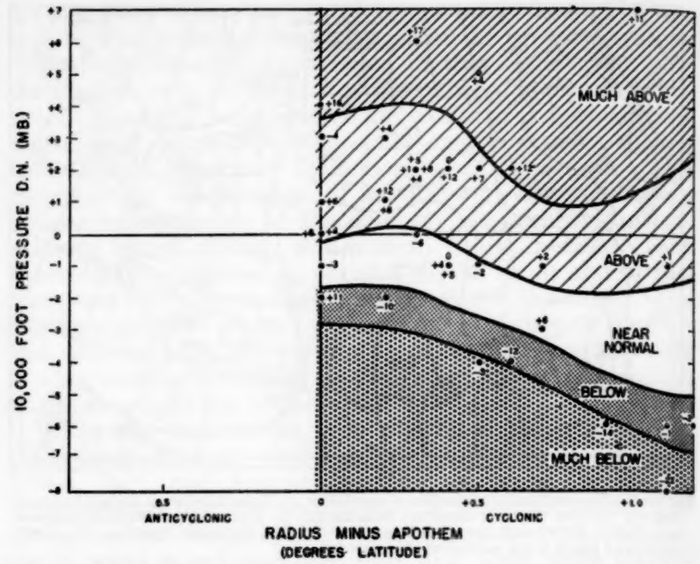

FIGURE 9.—Estimate of winter surface temperature anomaly at Bismarck on the basis of "radius minus apothem" curvature measure (abscissa) and 10,000-ft. pressure departure from normal (ordinate).

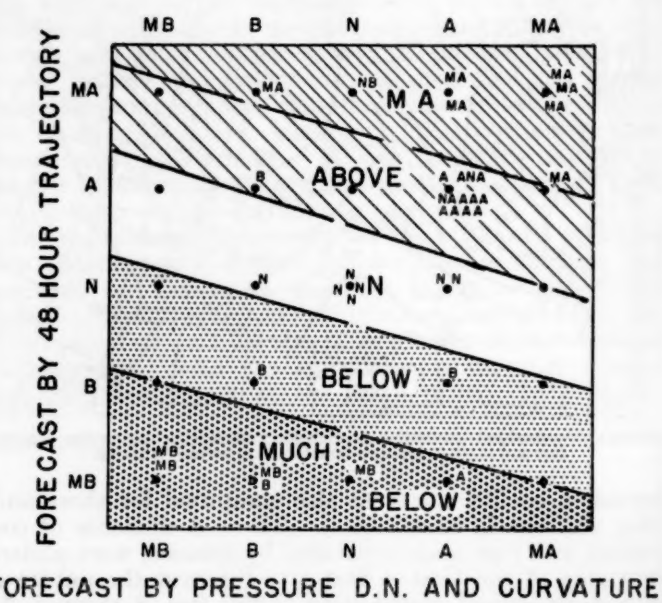

FIGURE 10.—Forecast of surface temperature anomaly at Bismarck in winter based on estimates from curvature-and-departure-from-normal graph (see figure 9) and trajectory source (see figure 3). Observed anomalies are plotted by letter at appropriate grid points.

Five-day mean patterns are more variable than monthly patterns. This is true both for pressure at a point and for the resultant wind speed and direction. As the first step in allowing for this factor, the variability of pressure, as measured by the standard deviation, was computed for 5-day and monthly maps for a number of points scattered over the country. A similar operation was conducted for values of zonal wind index (as reflective of pressure gradients). These tests showed that the variability on 5-day charts is approximately $1\frac{3}{5}$ times as large as the variability on monthly maps. This implies that the 5-day wind speed and pressure departure from normal must each be multiplied by $\frac{5}{8}$ before being used in the graphs. It is to be noted that this method neglects the fact that highly abnormal situations occur in the short-term mean pressure patterns without any counterpart during the longer periods.

It is also necessary to convert the measurements made from constant pressure charts now in use (700-mb.) to units of constant level. This involves dividing height departures from normal by 40. Although these modifications allow for corrections of pressure and gradient measurement, no reduction for curvature is available. As mentioned above, curvature adds little to the pressure departure term, hence it was decided to eliminate measurements of curvature from the routine.

DISCUSSION OF RESULTS OF FIRST METHOD

On monthly data this method is limited somewhat by its unwieldiness, but is not hampered by the necessity for conversions. To test its usefulness in prognostication it was applied to 2 years of independent data and the results were compared to those that would be expected by chance.

Observed monthly mean charts for the winters of 1945–46 and 1946–47 and for the summers of 1946 and 1947 were interpreted by this objective system. Two mean maps were used for each calendar month (overlapping twice-monthly means were introduced to increase the amount of test data) yielding a total of 12 individual (but not completely independent) cases for each of the 2 seasons for each of 15 stations (180 cases in all).

Table 1 shows the results of this test in contingency form for winter and summer. An examination of the winter section of the table reveals that 36 percent of the time the temperature estimates were exactly correct; 81 percent of the time they were within one class. The skill scores [4] are 17 for zero-class errors (exactly right) and 54 for zero-plus-one-class errors (within one class), a definite improvement over chance forecasting.

TABLE 1.—Contingency tables showing results of applying first objective method to independent monthly data for all test stations, winter 1945–46 and 1946–47, and summer 1946 and 1947.

WINTER

FORECAST \ OBSERVED	MB	B	N	A	MA	TOTAL
MB	7	5	2	5		19
B	5	6	2	6	1	20
N	3	7	10	22	6	48
A		6	22	34	14	76
MA			5	5	7	17
TOTAL	15	24	41	72	28	180

	O-CLASS ERRORS	(O+I)-CLASS ERRORS
%CORRECT	36	81
SKILL SCORE	17	54

SUMMER

FORECAST \ OBSERVED	MB	B	N	A	MA	TOTAL
MB	1					1
B	2	4	4	6	1	17
N	3	6	23	10	3	45
A	6	11	12	25	11	65
MA	1	9	15	16	11	52
TOTAL	13	30	54	57	26	180

	O-CLASS ERRORS	(O+I)-CLASS ERRORS
%CORRECT	36	69
SKILL SCORE	17	22

In summer the zero-class errors remain the same (36 percent), but the zero-plus-one-class errors drop to 69 percent. The corresponding skill scores are 17 and 22. These scores are sufficiently high to suggest usefulness in preparing monthly temperature estimates.

The worthiness of this method as reflected in these results can, at least in part, be explained by physical reasoning. The correlations between pressure and temperature departures and the effects of curvature have already been discussed. There is, though, a further influence of the curvature factor. Cyclonic conditions imply the presence of a trough and northerly currents advecting cold air; conversely for anticyclonic curvature. Since the trajectory already allows for this factor, there is additional evidence in favor of eliminating curvature as a parameter.

An examination of the trajectory charts reveals certain general rules for determining the temperature anomaly. Throughout the year at almost all stations the temperatures average higher than normal when the trajectories originate below a critical (for that station) latitude, and lower than normal for the more northerly trajectories. The critical latitude is usually that of the station itself except for cities in the lee of the Rocky Mountains for which the critical point is farther north. It is obvious that currents from the north should produce lower temperatures than currents from the south. The mountain effect is introduced when downslope motion produces foehn warming. This is illustrated in figure 3 for Bismarck where westerly through west-northwesterly components undergo downslope warming. The more northerly trajectories result in the colder anomalies.

The direction of flow apparently is important at maritime stations where water temperatures are radically different from the air temperatures over the land areas. This is strikingly illustrated by figure 11 which shows the temperature anomalies for Los Angeles according to the location of the trajectory origin ("72-hour" point for summer). Here the separation between warm and cold anomalies is markedly parallel to and along the coast.

At many stations the speed of the wind, or the distance over the trajectory path, is as significant as the direction of the flow. This is partly explained by the geographical distribution of land and water bodies. At continental stations in summer, for example, increasingly long trajectories apparently allow for increased heating of the air parcels (usually southwest of the station) and higher temperatures.

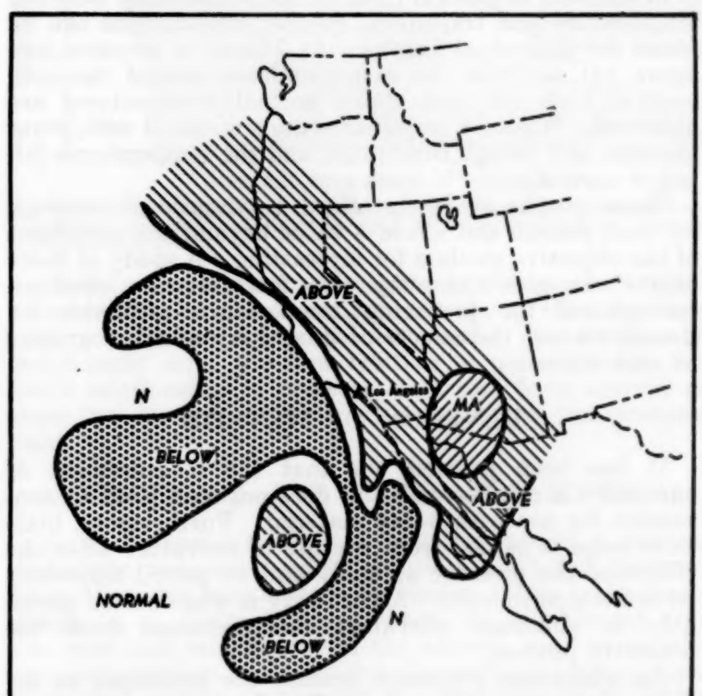

FIGURE 11.—Monthly mean temperature anomalies expected at Los Angeles in summer according to the geographical location of the source of the 72-hour trajectory.

[4] The skill scores were computed from the formula

$$S = \frac{\text{Number correct} - \text{Chance expectancy}}{\text{Total} - \text{Chance expectancy}} \times 100.$$

Chance expectancy is determined by the marginal totals of both predicted and observed classes. In a contingency table with subtotals P_i for predicted and O_i for observed and a total of N cases, the chance expectancy is

$$\frac{\Sigma[P_i \times O_i]}{N}.$$

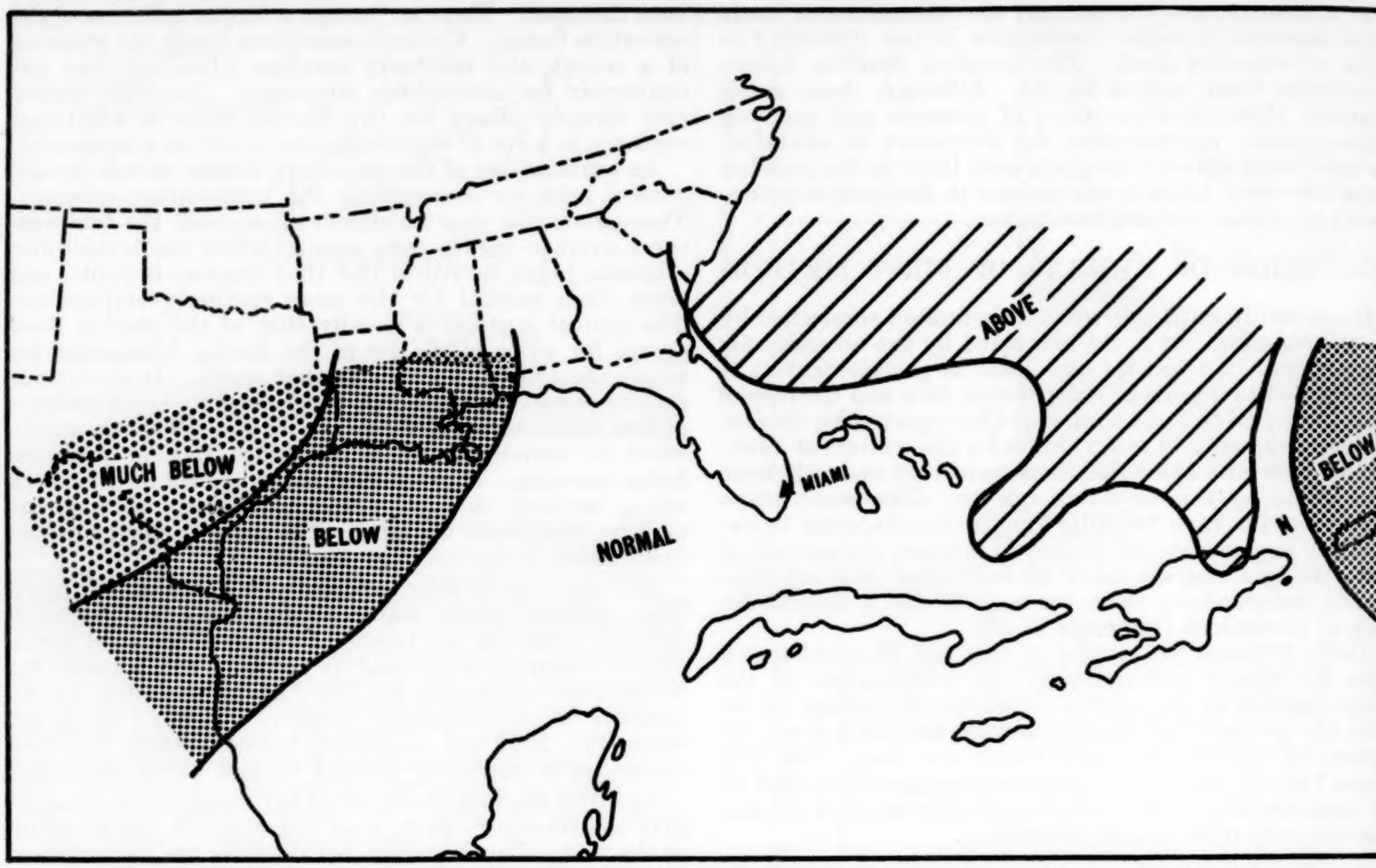

Figure 12.—Monthly mean temperature anomalies expected at Miami in summer according to the geographic location of the source of the 72-hour trajectory.

In addition to general rules on the relationship between temperature and trajectory, specific explanations can be found for individual graphs. At Miami in summer (see figure 12) air from the east circulates around the subtropical high cell and above normal temperatures are observed. Westerly trajectories are associated with lower pressure and trough conditions, and the temperatures fall below normal.

These graphs evidently afford a synoptic climatology for each station and afford a value beyond the usefulness of the objective method for forecasting. A study of these charts can give the subjective forecaster an excellent background for preparing temperature estimates by demonstrating the effects of geography and topography at each station.

REVISION OF METHOD

It has been pointed out that the measurement of curvature is cumbersome and does not lend itself to conversion for use with 5-day material. Furthermore, little knowledge is gained from the use of curvature after the effects of the pressure anomaly and air parcel trajectory have been considered. Accordingly it was deemed advisable to eliminate curvature measurements from the objective process.

An additional argument against the technique as developed to this point was the length of time required to prepare an anomaly estimate of temperature for the entire United States. It was therefore decided to shorten the procedure while salvaging those aspects which showed the most promise. The best parameters seemed to be the direction and magnitude of the flow near the station and the pressure departure from normal.

As a first step in the revision of the procedure it was decided to consider the mean wind speed and direction in the neighborhood of the station as a substitute for the elaborate computation of the trajectory. If departures from normal in speed and direction are used instead of the absolute (geostrophic) quantities, it is found that a single pressure anomaly chart contains information about all the desired parameters. The value of the pressure-departure chart has previously been recognized, and forecasters have utilized the data of this chart in forecasting the mean temperature field. Namias [5] states: "For the temperature anomalies one of the most important considerations is the comparison of flow patterns at sea level and aloft with the normal. This may be done by direct visual comparison, or perhaps better, by constructing pressure and height anomaly isograms."

Examination of a pressure anomaly chart (figure 13) shows that qualitative conclusions can be drawn immediately. In the northwest, for example, above normal pressures and flow more southerly than normal should be expected to lead to above normal temperatures. The goal is the reduction of this type of subjective reasoning to quantitative objective terms.

The pressure anomaly at any point of the chart can be determined by inspection once the isanomalous lines have been drawn. The measurement of geostrophic wind direction and speed (relative to normal) can be obtained by vector measures, and the vectors, in turn, can be

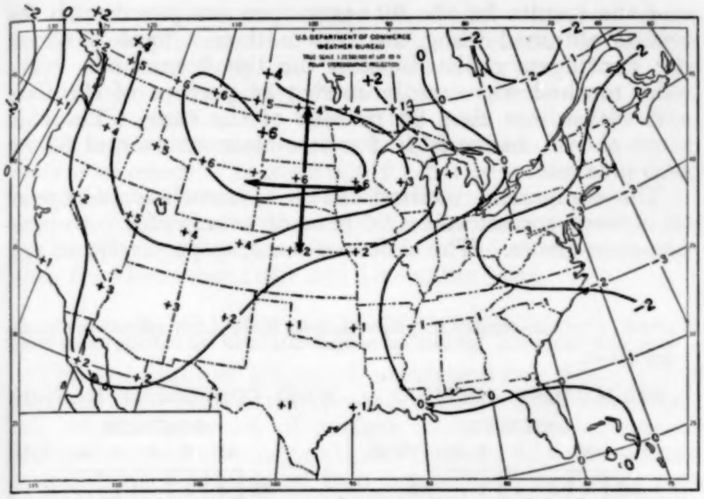

FIGURE 13.—Monthly 10,000-ft. pressure departures from normal for January 1942. Arrows indicate points for objective measurements.

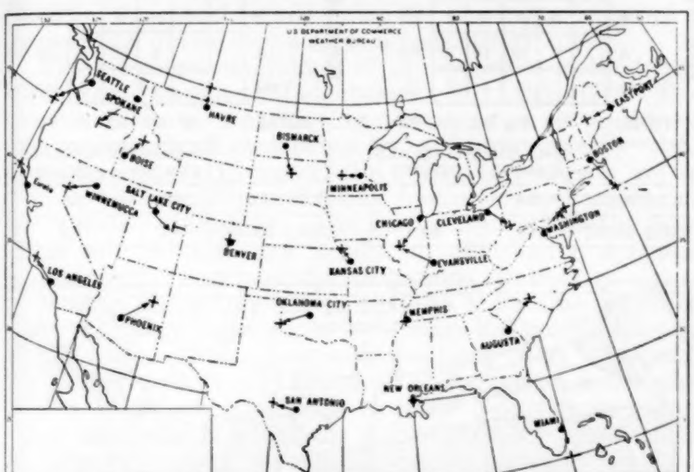

FIGURE 14.—Grid of points used in computing components of the geostrophic wind relative to normal.

broken into their north-south and west-east components. Finally, these components are directly proportional to the anomaly gradient, or to the anomaly difference across the unit length. Hence the pressure anomalies due north, east, south, and west of the station (or reasonably near) determine completely the direction and force of the geostrophic wind relative to normal at the station.

The ease of operation of this method permits an expansion of the study to include more points. Twenty-five stations were considered (including the earlier 15) and the 5-degree intersections of latitude and longitude most closely surrounding each station were selected as the grid points for pressure anomaly measurements. The resultant components of flow should approximate the results obtainable by using a grid of points removed exactly 5° from the station (which is not usually located on a 5° intersection of latitude and longitude). The network of points, shown in figure 14, has been reproduced on a transparent overlay which facilitates the measurements.

From examination of figure 13, it is seen that at Bismarck the pressure 5° to the west is 7 mb. above normal and 5° to the east only 6 mb. above normal. This indicates a flow at the station more northerly than normal, its strength shown on a relative basis by the magnitude of the difference (1 mb. in this case). Similarly the difference between the pressure anomalies 5° north and 5° south of Bismarck indicates a more easterly flow than

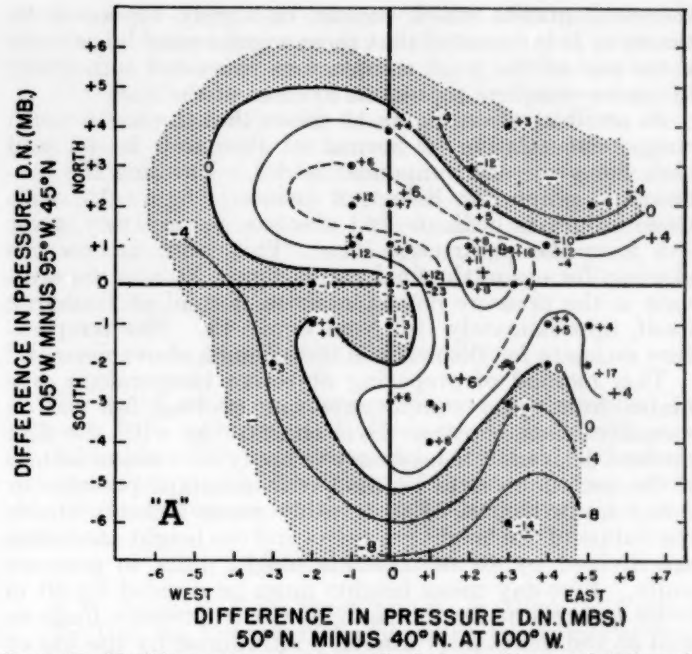

FIGURE 15.—Monthly mean temperature anomalies (in degrees F.) expected at Bismarck in winter according to the strength of the west-east wind component relative to normal (as abscissa) and the relative north-south component (as ordinate).

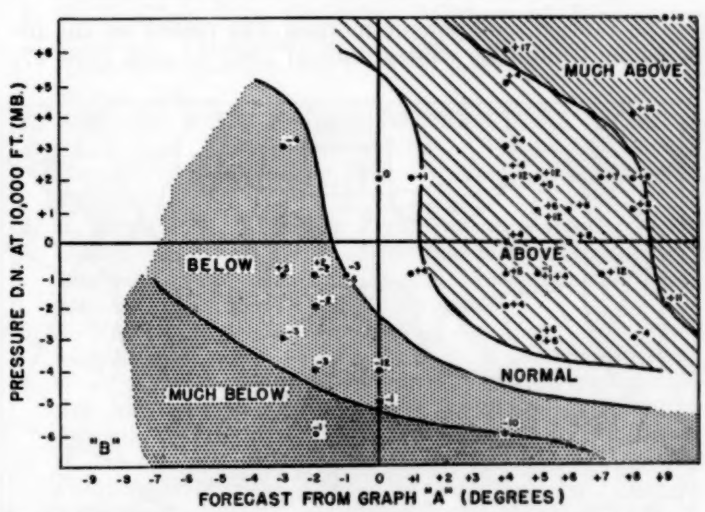

FIGURE 16.—Final forecast of temperature anomaly at Bismarck in winter on the basis of estimate from wind components (see figure 15) and 10,000-ft. pressure departure from normal (ordinate).

normal in proportion to the anomaly difference (2 mb.). Combination of the 2 components shows that the flow relative to normal is from the northeast. This is apparent graphically since the flow relative to normal obeys the same relationship to pressure departure from normal as does the geostrophic wind with respect to the pressure field.

OPERATIONAL USE OF REVISED METHOD

As in the earlier study (involving curvature), a graphic technique was employed to translate wind and pressure anomalies into temperature anomalies. The preliminary graph (e. g., figure 15) now charts the north-south and the west-east components of the relative wind as coordinate independent variables and the resultant of this graph is applied as the abscissa of the final estimating graph (figure 16). With the pressure departure from normal at the station as ordinate the final temperature estimate can be determined. Once again there are singularities in

the work graphs which cannot be simply explained by theory. It is expected that these wiggles would disappear if the size of the work sample were increased sufficiently to insure complete representativeness of the data.

As an illustration, figure 13 shows that the north-south component relative to normal at Bismarck is +1 and that the west-east component is +2. Entering the preliminary graph for Bismarck (winter), figure 15, with these values as ordinate and abscissa, respectively, gives +8 from the parametric lines. This value is now the abscissa for use in the final graph, figure 16, and the ordinate is the pressure departure from normal at Bismarck itself, approximately +6 from figure 13. The temperature estimate for Bismarck is then "much above normal."

This method of preparing objective temperature estimates from wind components was evolved for use on monthly mean constant level charts. As with the first method derived, it is necessary to apply conversion factors if the technique is to be used with constant pressure or 5-day mean charts. For monthly mean 700-mb. charts the values of the height gradients and the height anomalies are divided by 40 to translate height units to pressure units. Five-day mean heights must be divided by 60 in order to account for the change-over to pressure units as well as the increased variability introduced by the use of 5-day data.

EVALUATION OF REVISED METHOD

The revised, component method was tested on the independent monthly winter data of 1945–46 and 1946–47, and the results for the 90 cases were compared with the results obtained using the first method. Table 2 shows the contingency distributions for the 2 methods. The older method was exactly correct 34 percent of the time and within one class 84 percent of the time. The skill score above chance is 16 for zero-class errors and 62 for zero-plus-one.

The component method shows a zero-class average of 60 percent correct and a 96 percent average for zero-plus-one-class errors. The skill scores are, respectively, 49 and

Table 2.—Contingency tables showing comparison between first and revised objective methods of forecasting. Independent monthly data for all test stations, winter 1945–46 and 1946–47.

TRAJECTORY METHOD

FORECAST \ OBSERVED	MB	B	N	A	MA	TOTAL
MB	4	2	1	2		9
B	2	5	1	1		9
N	1	5	3	9	2	20
A		4	12	14	10	40
MA			3	4	5	12
TOTAL	7	16	20	30	17	90

	0-CLASS ERRORS	(0+1)-CLASS ERRORS
% CORRECT	34	84
SKILL SCORE	16	62

WIND COMPONENT METHOD

FORECAST \ OBSERVED	MB	B	N	A	MA	TOTAL
MB	3	2		1		6
B	3	9	2	1		15
N	1	5	11	5		22
A			6	22	8	36
MA			1	1	9	11
TOTAL	7	16	20	30	17	90

	0-CLASS ERRORS	(0+1)-CLASS ERRORS
% CORRECT	60	96
SKILL SCORE	49	89

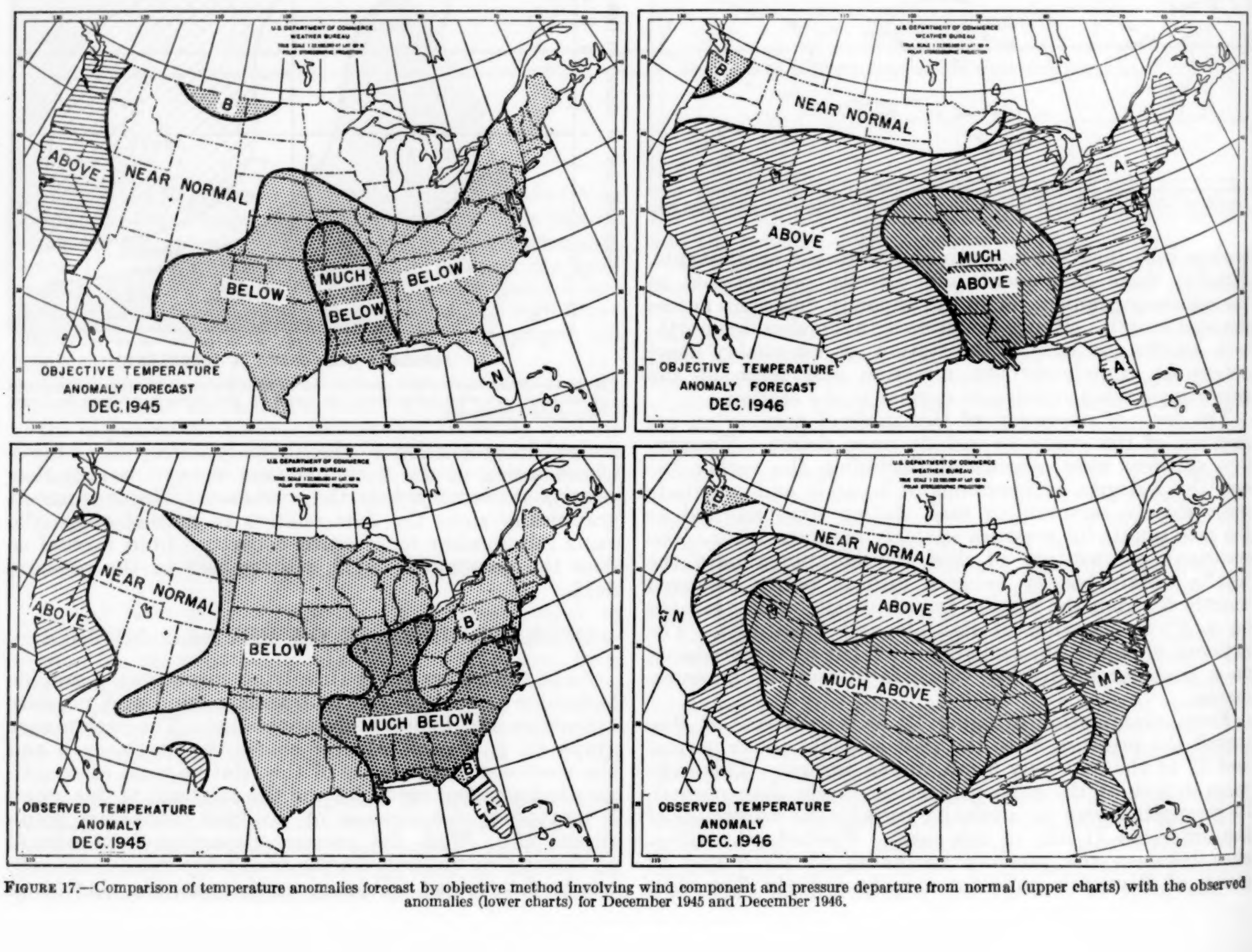

Figure 17.—Comparison of temperature anomalies forecast by objective method involving wind component and pressure departure from normal (upper charts) with the observed anomalies (lower charts) for December 1945 and December 1946.

89. It is perhaps surprising that the new method shows such an improvement over the old although the parameters are essentially the same in both methods. The difference may be partly due to sampling errors and errors in measurement. Not only is the later method quicker, but it is also more objective in application and less conducive to errors. It is certainly a better method in terms of efficient operation and effective results. Figure 17 depicts the operational value of this objective technique by comparing objective results with the observed anomalies for December 1945 and December 1946.

SUMMARY AND CONCLUSIONS

The technique of graphical correlation has thus yielded systems for objective interpretation of monthly mean 700-mb. charts in terms of surface temperature anomalies. Using observed monthly data, height anomaly charts have been correctly translated into temperature fields 60 percent of the time (96 percent for hits within one class). The final technique is simple to apply and is currently used in the monthly and 5-day forecasting routines as a forecasting device and also as a consistency check.

The prognostic usefulness of the objective methods has been tested elsewhere (Leight-Sartor [6]; Leight [7]). The results indicate that further investigation is necessary before objective forecasts can be used automatically without correction. However, the objective forecasts are of use to the monthly and 5-day forecasters as indications of expected conditions. The graphs from which the forecasts are obtained are helpful in affording a synoptic climatology for each of the 25 stations studied.

During the winter season 1947–48 it became apparent that the 5-day mean upper level maps did not completely explain the surface temperatures that were observed. Cold highs occasionally appeared at the surface under and ahead of trough conditions aloft on 5-day mean maps. Since comparable situations do not exist on mean maps of longer duration, the graphs, having been derived with the use of monthly data, did not yield the correct interpretations. This strongly suggests the necessity of utilizing another parameter in addition to height anomaly and vector flow. It has been recommended that changes from the initial temperature field or the thickness anomaly at the source of the trajectory must be considered for shorter-term forecasts.

A study to incorporate these and other factors into the objective procedure is currently in progress. To eliminate the necessity for conversion and resultant loss of reliability 5-day data are now being employed as source material. Intensive research is being directed toward identifying the key centers of action for determining the temperature anomaly for various locales; it has been discovered that broad features of the circulation are more effective than local phenomena in producing anomalous situations. A report will be forthcoming upon the completion of the newer work. The feasibility of objectivity in estimating temperatures has been demonstrated, and it is hoped that refinements of the technique will lead to greater efficiency in forecasting.

ACKNOWLEDGMENTS

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METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR OCTOBER 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see Review, January 1946, p. 6]

Table 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade and relative humidity in percent, for standard pressures, as obtained by radiosondes during October 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,011.4 mb.)				Albuquerque, N. Mex. (837.8 mb.)				Atlanta, Ga. (985.5 mb.)				Big Spring, Tex. (927.9 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	30	86	10.7	84	31	1,620	14.0	40	31	300	18.4	81	31	774	17.3	59
1,000	30	181	12.6	72	31	93	(*)	----	31	174	(*)	----	31	126	(*)	----
950	30	611	11.7	63	31	545	(*)	----	31	615	18.6	74	31	573	(*)	----
900	30	1,062	9.2	61	31	1,012	(*)	----	31	1,078	16.5	72	31	1,035	18.0	57
850	30	1,534	7.1	56	31	1,497	(*)	----	31	1,564	14.1	69	31	1,522	14.9	57
800	30	2,031	5.6	48	31	2,009	13.1	37	31	2,073	11.5	65	31	2,033	11.9	54
750	30	2,562	3.3	47	31	2,554	9.1	41	31	2,612	8.9	60	31	2,577	9.3	47
700	30	3,113	.9	44	31	3,115	4.6	46	31	3,179	5.8	59	31	3,141	6.1	43
650	30	3,707	-2.0	38	31	3,718	.3	50	31	3,786	2.6	57	31	3,745	2.5	42
600	30	4,338	-5.5	37	31	4,351	-4.3	48	31	4,426	-.8	51	31	4,386	-1.5	37
550	30	5,015	-9.9	34	31	5,033	-8.6	43	31	5,115	-4.7	46	30	5,076	-5.7	32
500	30	5,743	-14.3	31	31	5,763	-13.3	29	31	5,859	-9.2	43	30	5,815	-10.4	34
450	30	6,543	-19.3	----	30	6,564	-18.3	----	31	6,674	-14.4	39	30	6,625	-15.8	34
400	30	7,400	-25.3	----	29	7,427	-24.4	----	31	7,549	-20.7	----	30	7,496	-22.1	----
350	29	8,360	-32.9	----	29	8,385	-31.9	----	31	8,523	-27.4	----	29	8,465	-29.2	----
300	29	9,425	-41.0	----	28	9,455	-39.8	----	31	9,613	-35.6	----	28	9,548	-37.0	----
250	26	10,647	-49.6	----	27	10,676	-47.7	----	31	10,854	-45.4	----	27	10,786	-45.3	----
200	23	12,104	-57.7	----	23	12,116	-54.1	----	30	12,311	-55.7	----	27	12,246	-53.9	----
175	22	12,938	-60.2	----	22	12,970	-57.5	----	30	13,151	-60.7	----	22	13,098	-57.9	----
150	20	13,885	-62.8	----	20	13,948	-61.4	----	30	14,097	-65.8	----	21	14,058	-62.5	----
125	18	15,003	-64.5	----	18	15,064	-64.2	----	30	15,190	-70.1	----	19	15,171	-67.3	----
100	12	16,365	-66.9	----	10	16,434	-65.5	----	23	16,518	-72.8	----	14	16,502	-70.2	----
80	5	17,755	-62.6	----	----	----	----	----	12	17,830	-70.8	----	----	----	----	----

Standard pressure surface (mb.)	Bismarck, N. Dak. (954.4 mb.)				Boise, Idaho (917.5 mb.)				Brownsville, Tex. (1,012.9 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	505	6.5	73	31	868	8.4	58	31	6	23.7	85
1,000	31	116	(*)	----	31	145	(*)	----	31	118	23.8	81
950	31	546	(*)	----	31	581	(*)	----	31	571	21.7	77
900	31	987	6.7	58	31	1,027	10.0	48	31	1,035	19.3	72
850	31	1,455	4.3	59	31	1,501	8.1	43	31	1,526	17.0	68
800	31	1,946	1.8	60	31	1,999	4.9	44	31	2,042	15.0	57
750	31	2,474	-.5	58	31	2,528	1.8	44	31	2,592	12.6	47
700	31	3,013	-3.4	58	31	3,075	-1.1	44	31	3,162	9.7	43
650	31	3,606	-6.8	60	31	3,665	-4.4	44	31	3,778	6.6	40
600	31	4,217	-10.1	59	31	4,289	-8.1	44	31	4,426	2.4	39
550	31	4,892	-14.1	54	31	4,960	-12.3	44	31	5,124	-1.8	33
500	31	5,600	-18.7	51	31	5,682	-17.0	45	31	5,876	-6.2	----
450	31	6,389	-23.9	----	31	6,471	-22.4	----	31	6,700	-11.5	----
400	31	7,228	-29.5	----	31	7,319	-28.5	----	31	7,586	-17.7	----
350	31	8,167	-36.6	----	31	8,262	-35.4	----	31	8,571	-24.4	----
300	31	9,217	-44.2	----	30	9,317	-43.0	----	29	9,677	-32.6	----
250	29	10,412	-51.5	----	29	10,536	-50.4	----	27	10,935	-42.0	----
200	29	11,843	-55.7	----	23	11,971	-56.0	----	26	12,406	-53.4	----
175	28	12,692	-56.9	----	18	12,819	-57.4	----	25	13,259	-59.6	----
150	26	13,650	-56.7	----	12	13,788	-59.0	----	25	14,209	-65.9	----
125	21	14,813	-57.7	----	6	14,954	-60.8	----	23	15,287	-72.3	----
100	13	16,218	-59.9	----	----	----	----	----	13	16,609	-76.6	----
80	8	17,644	-58.1	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Buffalo, N. Y. (994.5 mb.)				Camaguey, Cuba [1] (—— mb.)				Caribou, Maine (997.0 mb.)				Charleston, S. C. (1,017.7 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	221	12.3	75	----	----	----	----	31	191	6.8	80	31	18	18.6	93
1,000	31	174	(*)	----	----	----	----	----	31	164	(*)	----	31	170	20.4	84
950	31	608	13.7	59	----	----	----	----	31	592	8.9	61	31	616	19.0	77
900	31	1,061	11.1	54	----	----	----	----	31	1,036	7.0	57	31	1,077	16.6	72
850	31	1,536	8.4	50	----	----	----	----	31	1,504	4.5	53	31	1,563	14.1	66
800	31	2,035	5.9	45	----	----	----	----	31	1,996	2.4	49	31	2,073	11.8	61
750	30	2,566	3.8	41	----	----	----	----	31	2,520	.2	52	31	2,617	9.5	54
700	30	3,119	1.0	41	----	----	----	----	31	3,066	-2.4	48	31	3,181	6.6	48
650	29	3,711	-2.2	42	----	----	----	----	31	3,655	-5.2	43	31	3,793	3.4	44
600	28	4,344	-5.3	39	----	----	----	----	31	4,276	-8.5	41	31	4,432	.0	40
550	28	5,024	-9.0	36	----	----	----	----	31	4,948	-12.3	37	31	5,127	-3.9	38
500	28	5,753	-13.7	35	----	----	----	----	31	5,669	-16.7	----	31	5,871	-8.3	37
450	28	6,551	-18.9	33	----	----	----	----	30	6,456	-21.7	----	30	6,687	-13.2	35
400	28	7,412	-25.5	----	----	----	----	----	30	7,306	-27.3	----	29	7,569	-19.5	32
350	27	8,364	-32.5	----	----	----	----	----	30	8,255	-33.8	----	29	8,548	-26.5	----
300	27	9,431	-40.3	----	----	----	----	----	30	9,319	-41.0	----	29	9,642	-34.7	----
250	27	10,650	-49.2	----	----	----	----	----	30	10,537	-48.7	----	28	10,890	-44.3	----
200	25	12,082	-56.7	----	----	----	----	----	30	11,982	-54.7	----	27	12,353	-54.3	----
175	22	12,952	-59.3	----	----	----	----	----	30	12,832	-56.5	----	27	13,198	-59.5	----
150	18	13,903	-61.7	----	----	----	----	----	29	13,800	-57.9	----	27	14,151	-64.8	----
125	12	15,082	-65.9	----	----	----	----	----	25	14,942	-59.1	----	27	15,249	-69.6	----
100	6	16,464	-66.9	----	----	----	----	----	18	16,321	-59.7	----	22	16,566	-71.9	----
80	----	----	----	----	----	----	----	----	----	----	----	----	20	17,884	-68.9	----
60	----	----	----	----	----	----	----	----	----	----	----	----	10	19,641	-63.7	----

Standard pressure surface (mb.)	Ciudad Victoria, Mex. (973.1 mb.)				Columbia, Mo. (989.7 mb.)				Dodge City, Kans. (924.6 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	335	26.7	57	31	239	14.8	69	31	792	13.0	69
1,000	31	92	(*)	----	31	150	(*)	----	31	122	(*)	----
950	31	548	25.1	57	31	591	15.6	60	31	562	(*)	----
900	31	1,019	20.9	62	31	1,044	12.9	61	31	1,019	14.9	56
850	31	1,511	17.3	69	31	1,523	10.8	57	31	1,502	13.4	52
800	31	2,026	13.9	76	31	2,027	8.7	51	31	2,011	11.0	48
750	31	2,575	11.5	67	31	2,565	6.2	48	31	2,551	7.9	47
700	31	3,144	9.1	53	31	3,122	3.5	41	31	3,112	4.3	45
650	30	3,758	5.5	43	31	3,724	.3	40	31	3,715	.8	40
600	29	4,406	1.7	41	31	4,357	-3.3	38	30	4,349	-3.2	33
550	28	5,101	-2.7	39	30	5,044	-7.3	34	30	5,033	-7.9	----
500	28	5,851	-7.0	32	30	5,774	-12.0	33	30	5,766	-13.0	----
450	28	6,674	-11.9	----	30	6,580	-17.6	----	30	6,564	-18.6	----
400	27	7,557	-18.5	----	30	7,446	-24.0	----	30	7,428	-24.9	----
350	26	8,540	-25.2	----	30	8,406	-31.2	----	30	8,385	-32.0	----
300	26	9,640	-33.6	----	29	9,480	-38.9	----	29	9,454	-40.1	----
250	26	10,892	-43.7	----	29	10,707	-47.2	----	29	10,675	-48.6	----
200	26	12,353	-55.4	----	27	12,153	-55.1	----	29	12,116	-55.5	----
175	25	13,191	-61.9	----	24	12,992	-59.0	----	27	12,963	-58.6	----
150	24	14,135	-68.6	----	22	13,966	-62.7	----	26	13,930	-62.1	----
125	23	15,213	-75.2	----	17	15,092	-65.8	----	25	15,042	-64.8	----
100	20	16,494	-78.7	----	8	16,478	-67.2	----	24	16,402	-66.9	----
80	14	17,796	-75.1	----	----	----	----	----	16	17,741	-63.6	----
60	6	19,527	-67.7	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	El Paso, Tex. (881.4 mb.)				Ely, Nev. (809.0 mb.)				Glasgow, Mont. (938.9 mb.)				Grand Junction, Colo. (852.3 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	30	1,195	18.0	42	31	1,908	5.9	60	31	648	6.3	66	31	1,474	10.8	58
1,000	30	94	(*)	----	31	125	(*)	----	31	124	(*)	----	31	112	(*)	----
950	30	549	(*)	----	31	566	(*)	----	31	553	(*)	----	31	555	(*)	----
900	30	1,019	(*)	----	31	1,024	(*)	----	31	995	6.3	58	31	1,017	(*)	----
850	30	1,505	17.5	41	31	1,497	(*)	----	31	1,461	3.4	56	31	1,495	(*)	----
800	30	2,020	14.0	44	31	2,000	9.0	50	31	1,950	.5	58	31	2,004	10.6	47
750	30	2,564	10.1	47	31	2,535	5.8	49	31	2,471	-2.7	61	31	2,543	6.9	49
700	30	3,131	5.9	50	31	3,093	2.0	51	31	3,010	-5.4	64	31	3,101	2.9	52
650	30	3,735	1.7	47	31	3,688	-1.9	50	31	3,595	-8.2	61	31	3,699	-1.3	52
600	30	4,375	-2.3	40	31	4,320	-5.9	52	31	4,206	-11.9	58	31	4,330	-5.9	54
550	29	5,063	-6.5	36	31	4,997	-10.6	52	31	4,870	-15.9	56	31	5,008	-10.4	47
500	28	5,799	-11.3	----	31	5,722	-15.6	49	31	5,579	-20.5	----	30	5,733	-14.8	39
450	27	6,603	-17.1	----	31	6,514	-20.9	----	30	6,351	-25.8	----	30	6,530	-20.1	35
400	27	7,473	-23.4	----	31	7,369	-27.2	----	30	7,190	-31.5	----	30	7,385	-26.6	----
350	26	8,435	-30.6	----	31	8,317	-34.1	----	28	8,115	-38.5	----	29	8,331	-33.6	----
300	26	9,512	-38.6	----	31	9,379	-41.9	----	28	9,157	-45.9	----	27	9,412	-41.2	----
250	24	10,741	-46.3	----	31	10,591	-49.9	----	27	10,357	-51.8	----	27	10,625	-49.4	----
200	19	12,182	-55.0	----	25	12,023	-55.7	----	23	11,787	-56.1	----	27	12,064	-55.3	----
175	18	13,021	-59.8	----	25	12,870	-57.8	----	17	12,651	-56.7	----	25	12,926	-57.7	----
150	14	13,995	-65.3	----	22	13,839	-60.0	----	7	13,629	-55.2	----	25	13,892	-60.0	----
125	9	15,074	-68.2	----	18	14,954	-61.3	----	----	----	----	----	17	15,043	-62.2	----
100	5	16,388	-70.8	----	15	16,324	-62.9	----	----	----	----	----	8	16,428	-65.4	----
80	----	----	----	----	9	17,676	-60.6	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Great Falls, Mont. (887.3 mb.)				Greensboro, N. C. (989.8 mb.)				Hatteras, N. C. (1,020.5 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	1,128	5.1	64	31	273	14.5	89	31	3	20.1	85
1,000	31	136	(*)	----	31	187	(*)	----	31	179	19.7	79
950	31	572	(*)	----	31	623	17.0	68	31	621	17.0	77
900	31	1,016	(*)	----	31	1,083	14.7	71	31	1,079	14.4	74
850	31	1,478	4.4	56	31	1,565	11.9	71	31	1,561	12.3	66
800	31	1,969	1.4	56	31	2,071	9.7	63	31	2,068	10.1	58
750	31	2,489	-1.5	57	31	2,609	7.7	53	31	2,606	7.8	51
700	31	3,032	-4.8	57	31	3,171	5.2	50	31	3,169	5.2	49
650	31	3,617	-8.0	56	31	3,776	2.0	47	31	3,777	2.2	42
600	31	4,228	-11.8	51	31	4,415	-1.7	44	31	4,413	-1.5	44
550	31	4,893	-16.2	48	31	5,104	-5.9	39	31	5,102	-5.5	39
500	31	5,600	-20.7	47	31	5,843	-10.2	37	31	5,843	-9.9	36
450	31	6,380	-25.6	----	31	6,652	-15.4	36	31	6,658	-15.3	----
400	31	7,216	-31.3	----	31	7,527	-21.8	----	31	7,528	-21.5	----
350	30	8,150	-38.2	----	31	8,495	-29.0	----	30	8,501	-28.5	----
300	30	9,192	-45.7	----	31	9,579	-37.1	----	30	9,586	-36.7	----
250	27	10,409	-52.9	----	31	10,815	-45.9	----	29	10,824	-45.5	----
200	22	11,810	-57.2	----	30	12,271	-55.1	----	28	12,282	-55.0	----
175	16	12,655	-57.8	----	28	13,110	-59.9	----	25	13,119	-60.1	----
150	12	13,614	-57.4	----	25	14,069	-64.7	----	19	14,090	-65.2	----
125	6	14,757	-58.4	----	16	15,185	-68.4	----	16	15,196	-69.5	----
100	----	----	----	----	10	16,527	-69.4	----	11	16,521	-70.7	----
80	----	----	----	----	----	----	----	----	7	17,859	-67.0	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during October 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba[1] (—— mb.)				Honolulu, T. H. (1,014.8 mb.)				International Falls, Minn. (970.6 mb.)				Joliet, Ill. (997.4 mb.)				Lake Charles, La. (1,014.9 mb.)				Lander, Wyo. (829.3 mb.)				Las Vegas, Nev. (936.1 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface					31	3	26.7	61	31	360	5.1	79	31	178	12.2	78	31	5	21.2	89	31	1,696	4.1	65	31	660	17.7	25
1,000					31	133	24.6	64	31	113	(*)		31	156	(*)		31	134	21.8	86	31	140	(*)		31	87	(*)	
950					31	581	20.8	71	31	535	6.3	72	31	590	13.9	63	31	583	19.6	84	31	575	(*)		31	532	(*)	
900					31	1,047	17.3	75	31	978	4.5	67	31	1,042	11.2	63	31	1,044	17.0	82	31	1,026	(*)		31	1,000	20.6	23
850					31	1,533	14.1	74	31	1,442	2.8	64	31	1,518	8.7	62	31	1,531	14.9	75	31	1,492	(*)		31	1,489	16.6	27
800					31	2,043	12.4	57	31	1,931	.4	61	31	2,018	6.6	57	31	2,042	12.7	62	31	1,990	5.8	53	31	2,001	12.4	32
750					31	2,588	11.1	38	31	2,452	−2.0	58	31	2,550	4.5	51	31	2,590	10.3	56	31	2,521	3.1	51	31	2,543	7.9	37
700					31	3,157	8.8	25	31	2,993	−4.3	56	31	3,104	2.0	44	31	3,154	7.1	56	31	3,071	−.2	51	31	3,102	4.0	37
650					31	3,770	5.7		31	3,579	−7.5	56	31	3,699	−1.3	40	31	3,764	3.6	48	31	3,664	−3.7	52	31	3,705	.1	36
600					31	4,417	2.3		31	4,193	−11.1	52	31	4,332	−4.8	33	31	4,406	.0	45	31	4,289	−7.2	49	31	4,337	−4.1	34
550					30	5,118	−1.4		31	4,860	−14.9	40	31	5,009	−8.6	31	31	5,100	−4.1	40	31	4,965	−11.2	46	30	5,016	−8.2	
500					30	5,868	−6.3		31	5,571	−19.5	35	31	5,744	−13.3	32	31	5,844	−8.6	38	31	5,686	−16.2	45	30	5,749	−13.4	
450					30	6,691	−12.2		31	6,355	−24.7		31	6,542	−19.2		31	6,662	−13.7	38	31	6,480	−22.0		30	6,547	−19.5	
400					30	7,573	−19.0		31	7,193	−30.5		31	7,403	−25.5		31	7,539	−19.9	39	31	7,327	−28.2		30	7,406	−26.2	
350					30	8,552	−26.7		31	8,129	−36.7		31	8,357	−32.6		31	8,515	−27.1		31	8,271	−35.3		30	8,358	−33.3	
300					30	9,645	−35.2		31	9,181	−43.4		31	9,425	−40.7		31	9,607	−35.4		31	9,326	−43.2		30	9,424	−41.0	
250					30	10,891	−44.8		31	10,389	−49.8		31	10,643	−49.3		30	10,846	−45.5		30	10,526	−51.4		27	10,637	−49.1	
200					28	12,343	−55.8		30	11,830	−54.9		29	12,090	−56.7		29	12,294	−56.3		29	11,955	−56.7		26	12,088	−55.5	
175					27	13,183	−61.0		30	12,682	−55.2		28	12,936	−59.5		29	13,131	−61.6		28	12,799	−58.3		24	12,930	−57.8	
150					27	14,129	−65.9		22	13,674	−55.7		27	13,884	−62.4		28	14,069	−67.2		25	13,775	−59.7		21	13,873	−60.3	
125					24	15,228	−69.2		19	14,832	−56.7		26	15,016	−65.3		24	15,154	−72.3		25	14,909	−61.1		20	14,996	−62.5	
100					21	16,540	−72.8		8	16,209	−57.4		22	16,374	−66.0		19	16,449	−75.0		14	16,314	−62.7		13	16,379	−65.1	
80					15	17,859	−70.7						15	17,750	−63.9		14	17,746	−71.4		7	17,701	−61.5					
60					7	19,590	−64.3										9	19,477	−65.9									
50																	6	20,615	−61.9									

Standard pressure surface (mb.)	Little Rock, Ark. (1,008.6 mb.)				Mazatlan, Mex. (1,008.1 mb.)				Medford, Oreg. (972.2 mb.)				Merida, Mex. (1,009.7 mb.)				Miami, Fla. (1,015.5 mb.)				Nantucket, Mass. (1,020.9 mb.)				Nashville, Tenn. (998.6 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	79	16.7	86	31	14	27.8	73	31	401	10.3	71	29	27	25.9	84	31	4	24.9	82	30	14	12.4	87	31	177	17.1	81
1,000	31	152	18.7	74	31	86	27.3	73	31	165	(*)		29	113	25.6	83	31	139	25.3	78	30	188	13.8	75	31	166	(*)	
950	31	595	17.4	69	31	549	25.1	68	31	598	12.3	56	29	564	23.2	81	31	592	22.3	80	30	623	12.3	64	31	608	17.1	68
900	31	1,052	14.6	70	31	1,014	22.5	71	31	1,046	10.0	56	29	1,036	20.3	80	31	1,059	19.3	78	30	1,072	10.7	53	31	1,065	14.8	68
850	31	1,535	12.8	65	31	1,510	19.6	69	31	1,519	7.2	57	29	1,527	17.2	77	31	1,549	16.4	73	30	1,547	9.3	48	31	1,547	12.3	67
800	31	2,043	10.8	64	31	2,031	16.6	64	31	2,015	4.6	57	29	2,044	14.3	74	31	2,063	14.0	65	30	2,048	7.5	45	31	2,054	10.1	61
750	21	2,584	8.4	59	31	2,586	13.6	58	31	2,548	2.6	45	29	2,591	11.6	70	31	2,609	11.7	55	30	2,582	5.3	39	31	2,594	7.8	57
700	31	3,147	5.8	54	31	3,157	10.1	57	31	3.095	.1	40	29	3,163	9.2	58	31	3,181	9.0	47	30	3,139	3.0	38	31	3,155	5.2	52
650	31	3,756	2.8	51	29	3,775	6.3	52	31	3,688	−3.1	41	29	3,778	6.1	53	31	3,792	5.6	46	30	3,738	−.1		31	3,763	1.9	50
600	29	4,397	−.7	44	28	4,423	1.9	50	31	4,314	−6.9	36	27	4,425	2.3	50	31	4,441	2.0	42	29	4,373	−3.2		31	4,399	−1.8	49
550	29	5,087	−4.8	42	28	5,124	−2.4	47	31	4,987	−11.4	33	27	5,123	−1.6	41	31	5,140	−2.1	40	29	5,056	−7.4		31	5,086	−5.7	46
500	29	5,830	−9.4	37	28	5,871	−6.7	38	31	5,712	−16.4	32	27	5,876	−6.3	41	31	5,890	−6.5	36	29	5,791	−11.7		31	5,826	−10.4	44
450	29	6,642	−15.0	33	27	6,696	−11.8	32	31	6,503	−21.8		26	6,698	−11.3	34	30	6,710	−11.8	34	29	6,600	−17.0		30	6,638	−15.8	42
400	29	7,517	−21.5		27	7,581	−17.7		31	7,355	−27.5		25	7,585	−17.6		30	7,598	−17.7	33	28	7,460	−23.5		30	7,509	−21.7	
350	28	8,484	−28.9		27	8,566	−24.8		31	8,302	−34.1		25	8,571	−24.8		30	8,582	−24.8		28	8,423	−30.4		30	8,479	−28.9	
300	28	9,569	−36.5		27	9,667	−33.3		31	9,363	−41.9		25	9,672	−33.3		30	9,683	−33.4		28	9,500	−38.5		30	9,563	−37.0	
250	27	10,815	−44.9		27	10,924	−42.9		29	10,566	−50.6		25	10,926	−43.4		30	10,936	−43.4		28	10,728	−47.5		29	10,804	−46.0	
200	25	12,282	−54.3		26	12,394	−54.4		27	12,002	−57.8		25	12,386	−55.7		29	12,398	−55.0		26	12,164	−56.1		28	12,251	−55.3	
175	23	13,117	−58.8		26	13,237	−61.0		22	12,864	−60.7		25	13,222	−62.7		27	13,242	−60.8		24	13,007	−59.1		28	13,093	−59.7	
150	19	14,076	−63.4		25	14,177	−68.0		18	13,827	−62.4		23	14,154	−70.2		22	14,193	−66.3		24	13,966	−61.7		27	14,045	−64.0	
125	13	15,169	−68.2		22	15,258	−73.2		10	14,996	−64.7		18	15,209	−76.3		15	15,292	−71.8		22	15,088	−63.6		23	15,141	−67.5	
100	9	16,483	−69.0		19	16,548	−76.7						13	16,491	−80.0		7	16,614	−74.1		16	16,470	−65.0		12	16,460	−69.1	
80					16	17,834	−73.3						10	17,752	−74.8						7	17,824	−63.0					
60					10	19,537	−66.9																					

Standard pressure surface (mb.)	New Orleans, La. (1,016.2 mb.)				North Platte, Nebr. (917.4 mb.)				Oakland, Calif. (1,015.1 mb.)				Oklahoma City, Okla. (971.1 mb.)				Omaha, Nebr. (980.1 mb.)				Phoenix, Ariz. (972.5 mb.)				Pittsburgh, Pa. (976.3 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	2	22.4	88	31	849	9.4	72	31	6	14.2	73	31	391	15.3	76	31	308	13.9	67	31	339	19.7	48	31	382	14.4	67
1,000	31	142	23.0	84	31	121	(*)		31	133	15.0	67	31	139	(*)		31	136	(*)		31	95	(*)		31	177	(*)	
950	31	591	20.7	80	31	559	(*)		31	574	16.2	49	31	579	16.7	68	31	572	14.1	56	31	547	24.2	31	31	618	15.5	62
900	31	1,055	18.5	77	31	1,008	11.3	61	31	1,027	15.2	38	31	1,036	14.2	65	31	1,026	12.0	57	31	1,013	21.0	32	31	1,070	12.9	62
850	31	1,544	15.8	73	31	1,485	9.6	55	31	1,510	13.0	34	31	1,518	12.3	58	31	1,503	10.0	58	31	1,503	16.9	35	31	1,549	10.2	61
800	31	2,058	13.2	65	31	1,987	7.9	53	31	2,016	10.4	34	31	2,025	10.2	53	31	2,005	7.4	54	31	2,016	12.5	41	31	2,051	7.8	59
750	31	2,601	10.6	58	31	2,524	5.3	48	31	2,556	7.4	34	31	2,566	8.3	45	31	2,539	4.7	50	31	2,559	8.2	46	31	2,589	5.6	51
700	31	3,171	7.9	51	31	3,078	2.4	46	31	3,116	4.1	32	31	3,127	5.4	38	31	3,093	1.7	48	31	3,118	4.7	44	31	3,143	3.2	47
650	31	3,780	4.3	49	31	3,675	−1.6	45	31	3,717	.2	30	31	3,732	1.7	34	31	3,692	−1.9	44	31	3,729	.9	40	31	3,747	.3	44
600	31	4,429	1.1	46	31	4,305	−5.8	46	30	4,359	−3.2	30	31	4,369	−2.3	33	31	4,320	−5.4	39	31	4,357	−2.8	34	31	4,379	−3.5	45
550	29	5,122	−2.7	41	31	4,983	−10.1	45	30	5,041	−7.8	30	31	5,056	−6.5	30	31	4,998	−9.4	34	31	5,044	−7.2	29	31	5,066	−7.3	41
500	29	5,876	−7.1		31	5,712	−14.9	39	30	5,777	−12.6	28	30	5,795	−11.3	29	31	5,729	−14.3	30	31	5,776	−12.0	25	30	5,804	−11.4	36
450	28	6,698	−12.2		29	6,504	−20.5		30	6,579	−18.2	28	30	6,601	−16.9	30	31	6,527	−19.5	29	31	6,580	−17.4		30	6,610	−17.0	
400	28	7,582	−18.2		29	7,360	−26.8		30	7,443	−24.6		30	7,469	−23.4		31	7,385	−26.0		31	7,444	−24.2		30	7,477	−23.3	
350	26	8,567	−25.3		29	8,309	−34.2		29	8,400	−32.2		30	8,431	−30.8		31	8,338	−32.9		31	8,403	−31.7		25	8,453	−30.4	
300	26	9,668	−33.4		29	9,368	−42.6		29	9,470	−40.6		30	9,507	−38.7		31	9,405	−40.6		30	9,475	−39.7		22	9,533	−38.7	
250	26	10,924	−42.9		29	10,577	−50.6		26	10,679	−49.3		30	10,737	−46.9		31	10,625	−49.0		29	10,705	−47.5		17	10,756	−47.7	
200	24	12,401	−53.4		28	12,005	−56.3		22	12,138	−57.0		30	12,188	−54.9		29	12,061	−56.2		28	12,156	−54.4		12	12,250	−55.1	
175	23	13,244	−59.5		25	12,853	−58.5		22	12,976	−60.0		26	13,050	−59.5		29	12,903	−58.8		24	13,009	−57.9		9	13,124	−58.4	
150	21	14,204	−65.4		24	13,808	−61.0		14	13,926	−62.2		23	14,010	−64.2		26	13,858	−60.9		22	13,977	−61.4		6	14,095	−63.5	
125	14	15,305	−70.6		21	14,942	−63.5		8	15,045	−63.4		19	15,126	−68.1		25	14,982	−62.4		17	15,094	−64.2		5	15,229	−68.5	
100	5	16,655	−74.9		16	16,299	−64.0						6	16,424	−69.2		23	16,346	−63.2		9	16,456	−67.6					
80					5	17,690	−63.6										14	17,721	−61.4									

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during October 1949*—Continued

Standard pressure surface (mb.)	Portland, Maine (1,019.3 mb.)				Rapid City, S. Dak. (902.5 mb.)				St. Cloud, Minn. (977.4 mb.)				San Antonio, Tex. (987.7 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	20	9.0	84	31	980	6.6	69	31	317	9.1	74	31	240	19.8	74
1,000	31	179	11.9	70	31	123	(*)	----	31	126	(*)	----	31	131	(*)	----
950	31	613	11.2	59	31	555	(*)	----	31	559	10.0	65	31	577	19.8	70
900	31	1,058	8.7	59	31	1,002	(*)	----	31	1,002	8.3	63	31	1,042	17.2	71
850	31	1,529	6.9	53	31	1,475	7.5	57	31	1,472	6.0	63	31	1,529	15.0	69
800	31	2,025	4.7	48	31	1,972	5.0	57	31	1,967	3.8	59	31	2,041	13.3	59
750	31	2,558	2.8	43	31	2,502	2.5	59	31	2,494	1.1	54	31	2,589	11.7	46
700	31	3,105	.2	41	31	3,052	−.5	59	31	3,042	−1.6	51	31	3,158	8.4	50
650	31	3,701	−2.4	37	31	3,646	−4.0	56	31	3,635	−4.9	53	31	3,768	4.5	52
600	31	4,327	−5.9	37	31	4,268	−7.8	53	31	4,254	−8.4	46	30	4,414	.5	42
550	31	5,007	−9.8	32	31	4,944	−11.6	48	31	4,928	−12.1	40	30	5,106	−3.4	35
500	31	5,733	−14.5	31	31	5,664	−16.5	48	31	5,648	−16.3	38	29	5,855	−7.8	----
450	31	6,529	−19.8	30	31	6,453	−21.9	----	31	6,439	−21.6	----	29	6,672	−13.4	----
400	31	7,386	−26.1	----	31	7,304	−28.2	----	31	7,292	−27.8	----	29	7,553	−19.4	----
350	30	8,344	−33.3	----	31	8,248	−35.3	----	31	8,238	−34.2	----	29	8,530	−26.7	----
300	27	9,422	−41.4	----	31	9,304	−42.6	----	31	9,300	−41.4	----	28	9,623	−34.9	----
250	25	10,632	−49.8	----	31	10,514	−50.3	----	29	10,505	−49.3	----	27	10,870	−43.9	----
200	21	12,078	−57.5	----	31	11,948	−55.9	----	29	11,948	−55.0	----	26	12,337	−53.3	----
175	18	12,907	−60.2	----	30	12,798	−57.6	----	28	12,804	−57.1	----	25	13,190	−58.7	----
150	15	13,853	−61.6	----	27	13,764	−58.2	----	27	13,786	−58.8	----	23	14,152	−64.3	----
125	10	14,971	−63.8	----	21	14,926	−59.3	----	23	14,934	−60.0	----	19	15,252	−69.6	----
100	9	16,324	−66.2	----	10	16,315	−61.3	----	12	16,286	−59.7	----	11	16,576	−72.7	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	San Juan, P. R. (1,012.3 mb.)				Santa Maria, Calif. (1,006.8 mb.)				Sault Ste. Marie, Mich. (990.7 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	15	25.7	84	31	71	12.4	81	31	221	8.0	85
1,000	31	122	25.5	82	31	128	13.0	76	31	143	(*)	----
950	31	576	22.9	80	31	567	15.5	55	31	574	9.5	68
900	31	1,044	19.9	79	31	1,022	16.7	37	31	1,016	7.7	64
850	31	1,535	16.9	75	31	1,507	14.1	33	31	1,485	5.4	62
800	31	2,051	14.4	67	31	2,015	11.1	31	31	1,979	3.4	55
750	31	2,599	11.8	59	31	2,556	8.2	29	31	2,505	.8	52
700	31	3,170	8.9	58	31	3,117	4.8	30	31	3,052	−2.1	49
650	31	3,785	5.4	52	31	3,721	1.2	28	31	3,638	−5.4	43
600	30	4,431	1.7	47	31	4,356	−2.6	25	30	4,259	−8.8	39
550	30	5,128	−2.5	45	31	5,042	−7.1	----	30	4,928	−12.8	38
500	30	5,878	−6.8	39	30	5,776	−11.7	----	29	5,652	−17.4	36
450	30	6,698	−12.0	36	30	6,582	−17.4	----	28	6,444	−22.5	----
400	30	7,585	−18.0	36	30	7,447	−24.1	----	28	7,292	−28.4	----
350	30	8,569	−25.0	----	30	8,406	−31.6	----	28	8,236	−35.0	----
300	30	9,670	−33.4	----	30	9,479	−39.4	----	28	9,294	−42.7	----
250	30	10,925	−43.5	----	30	10,704	−47.7	----	25	10,494	−50.8	----
200	29	12,386	−55.6	----	29	12,156	−54.3	----	23	11,929	−56.2	----
175	29	13,224	−62.1	----	25	13,021	−58.2	----	21	12,779	−57.7	----
150	28	14,160	−69.0	----	24	13,988	−61.3	----	17	13,788	−59.2	----
125	21	15,235	−74.9	----	20	15,100	−64.1	----	11	14,938	−61.0	----
100	14	16,523	−76.7	----	16	16,463	−65.6	----	6	16,353	−61.1	----
80	----	----	----	----	8	17,817	−65.1	----	----	----	----	----

Standard pressure surface (mb.)	Spokane, Wash. (933.6 mb.)				Swan Island, W. I. (1011.2 mb.)				Tacubaya, Mex. (773.7 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	721	7.1	60	31	10	27.0	81	30	2,306	17.4	57
1,000	31	150	(*)	----	31	109	26.5	81	30	51	(*)	----
950	31	579	(*)	----	31	560	23.5	82	30	513	(*)	----
900	31	1,024	7.7	52	31	1,033	20.9	78	30	994	(*)	----
850	31	1,492	4.6	53	31	1,526	18.1	77	30	1,491	(*)	----
800	31	1,984	1.5	54	31	2,045	15.2	75	30	2,020	(*)	----
750	31	2,505	−1.6	57	31	2,593	12.2	70	30	2,575	15.8	57
700	31	3,047	−4.4	52	31	3,166	9.5	63	30	3,154	11.5	64
650	31	3,632	−7.6	50	31	3,781	6.2	55	30	3,773	6.8	68
600	31	4,246	−11.3	49	31	4,432	2.6	53	30	4,423	2.1	71
550	30	4,916	−15.1	44	31	5,134	−1.3	49	30	5,123	−2.1	61
500	30	5,628	−19.7	40	31	5,886	−5.6	46	30	5,875	−6.0	42
450	28	6,414	−24.6	----	31	6,710	−10.9	43	29	6,702	−11.0	37
400	28	7,254	−30.6	----	30	7,601	−16.8	38	29	7,588	−17.0	36
350	28	8,189	−36.9	----	29	8,590	−23.9	----	29	8,575	−24.3	----
300	26	9,259	−43.6	----	29	9,697	−32.4	----	29	9,679	−32.9	----
250	23	10,468	−51.0	----	28	10,955	−42.4	----	29	10,936	−43.2	----
200	16	11,889	−56.7	----	26	12,423	−54.4	----	28	12,400	−55.5	----
175	11	12,740	−59.3	----	25	13,267	−60.9	----	28	13,237	−62.4	----
150	8	13,711	−60.0	----	24	14,208	−67.7	----	25	14,174	−69.4	----
125	----	----	----	----	18	15,299	−74.3	----	21	15,244	−75.5	----
100	----	----	----	----	12	16,578	−79.1	----	12	16,526	−78.6	----
80	----	----	----	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Tampa, Fla. (1016.4 mb.)				Tatoosh Island, Wash. (1015.8 mb.)				Toledo, Ohio (997.0 mb.)				Washington, D. C. (1019.4 mb.)			
	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity	Number of observations	Height	Temperature	Relative humidity
Surface	31	9	23.2	86	31	31	9.2	88	31	191	12.6	81	31	25	16.3	76
1,000	31	151	23.6	79	31	161	9.4	83	31	164	(*)	----	31	188	16.7	68
950	31	599	21.3	76	31	589	7.8	78	31	602	14.2	60	31	628	14.9	65
900	31	1,067	18.4	75	31	1,030	6.0	72	31	1,054	11.7	57	31	1,081	12.2	68
850	31	1,555	15.5	71	31	1,497	3.7	69	31	1,531	9.3	54	31	1,559	10.4	61
800	31	2,068	13.2	61	31	1,987	1.5	63	31	2,031	7.1	52	31	2,062	8.4	55
750	31	2,612	10.6	56	31	2,512	−1.2	57	31	2,564	4.9	48	31	2,600	6.2	51
700	31	3,181	7.8	50	31	3,053	−3.7	53	31	3,121	2.2	45	31	3,156	3.6	52
650	30	3,791	4.5	50	31	3,641	−6.9	48	31	3,719	−1.2	45	31	3,760	.5	50
600	30	4,437	.8	47	31	4,254	−10.8	47	31	4,350	−4.9	44	31	4,393	−2.9	44
550	30	5,130	−3.2	44	31	4,923	−14.7	45	30	5,030	−8.6	36	31	5,080	−7.2	43
500	30	5,879	−7.7	41	31	5,634	−18.8	44	30	5,758	−13.3	34	31	5,814	−11.5	35
450	29	6,699	−12.8	41	31	6,418	−23.8	----	30	6,556	−19.1	33	30	6,621	−16.9	36
400	29	7,581	−18.8	37	30	7,262	−29.8	----	30	7,419	−25.2	----	30	7,487	−23.4	----
350	29	8,560	−26.5	----	30	8,202	−35.5	----	30	8,374	−32.5	----	30	8,449	−30.4	----
300	28	9,653	−35.0	----	29	9,266	−42.4	----	30	9,442	−40.7	----	30	9,527	−38.4	----
250	28	10,898	−44.8	----	28	10,486	−49.5	----	30	10,659	−49.4	----	29	10,755	−47.7	----
200	25	12,348	−55.8	----	24	11,957	−57.0	----	30	12,094	−56.9	----	28	12,200	−56.1	----
175	23	13,189	−61.5	----	22	12,796	−58.1	----	29	12,939	−60.2	----	28	13,039	−60.4	----
150	20	14,133	−66.9	----	17	13,769	−59.2	----	23	13,885	−62.7	----	28	13,991	−63.7	----
125	20	15,218	−72.2	----	16	14,908	−59.7	----	20	14,987	−65.1	----	22	15,110	−67.3	----
100	15	16,531	−76.0	----	9	16,339	−59.9	----	13	16,318	−65.7	----	22	16,446	−68.6	----
80	5	17,854	−72.0	----	----	----	----	----	9	17,696	−63.9	----	14	17,795	−66.6	----
60	----	----	----	----	----	----	----	----	----	----	----	----	7	19,541	−63.1	----

[1] Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C. Relative humidity data beginning with October 1, 1948, were computed and expressed in these tables on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C, have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T. during October 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	29	144	1.5	31	195	2.6	29	86	1.4	27	261	4.2	29	273	3.1	30	320	3.6
500	---	---	---	---	---	---	29	80	1.8	---	---	---	---	---	---	---	---	---
1,000	29	152	1.8	---	---	---	27	137	1.9	---	---	---	29	272	5.1	30	315	3.2
1,500	27	197	2.5	---	---	---	25	158	1.8	27	271	6.8	26	272	6.6	30	302	2.6
2,000	25	213	2.7	31	204	4.3	23	217	1.6	26	281	8.1	22	270	8.9	30	298	3.5
2,500	23	234	3.5	31	223	4.3	21	254	2.6	25	286	10.2	21	275	11.3	30	291	4.9
3,000	21	244	4.7	30	229	4.6	20	254	3.3	25	282	11.2	20	272	12.1	30	290	5.7
4,000	21	235	7.6	29	259	6.5	18	261	4.7	19	285	15.5	17	277	15.5	27	292	7.1
5,000	16	237	7.9	26	273	7.8	18	268	6.6	15	301	17.5	14	272	17.6	22	299	8.0
6,000	14	248	9.0	26	278	8.2	16	285	7.4	12	289	19.8	12	274	19.1	21	301	10.6
8,000	12	239	14.6	20	280	9.1	---	---	---	---	---	---	---	---	---	13	308	13.0
10,000	---	---	---	20	275	13.3	---	---	---	---	---	---	---	---	---	---	---	---
12,000	---	---	---	12	264	11.7	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	29	99	3.0	30	248	1.8	31	221	1.7	30	82	2.1	30	212	0.8	31	215	1.4
500	29	99	2.8	30	248	3.3	31	225	3.7	30	78	3.7	30	205	1.6	---	---	---
1,000	26	133	1.6	30	228	5.2	30	244	5.0	27	79	3.4	29	203	2.6	---	---	---
1,500	18	196	.4	27	239	6.2	26	264	5.6	25	70	1.9	29	219	3.6	31	213	1.7
2,000	15	252	1.3	27	248	7.3	24	269	7.0	20	41	1.5	26	239	5.4	31	216	2.2
2,500	12	307	2.8	23	254	7.9	24	276	8.3	19	355	1.8	25	252	6.9	29	231	3.3
3,000	12	311	3.7	23	260	9.0	23	274	10.2	18	340	2.7	22	257	6.2	28	237	4.5
4,000	11	322	2.8	21	257	9.1	21	279	11.0	16	330	3.3	18	272	7.5	25	253	7.7
5,000	11	277	4.6	18	262	9.2	19	278	13.7	12	327	4.6	17	265	9.7	24	254	10.3
6,000	---	---	---	15	260	12.7	15	273	16.0	11	315	4.5	13	265	14.7	20	259	9.9
8,000	---	---	---	10	271	14.0	---	---	---	---	---	---	---	---	---	19	254	14.0
10,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	16	250	19.2
12,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	14	253	25.1

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	29	292	1.5	31	265	1.4	28	77	1.8	28	265	3.9	31	80	4.4	30	200	2.7
500	---	---	---	---	---	---	28	82	1.7	---	---	---	31	78	4.8	30	208	3.7
1,000	---	---	---	---	---	---	27	139	1.6	28	269	6.4	31	82	3.4	27	226	4.7
1,500	---	---	---	31	262	1.4	24	207	2.3	28	277	9.0	23	84	1.2	25	237	4.8
2,000	29	279	1.5	31	259	1.7	23	241	2.8	27	275	9.4	22	43	.9	23	253	6.2
2,500	29	264	2.3	31	247	2.8	22	254	3.6	25	290	10.4	18	287	1.2	23	260	7.0
3,000	29	281	2.5	29	248	3.8	21	271	4.9	20	296	13.0	14	323	2.5	21	261	7.7
4,000	25	288	4.0	25	270	5.2	20	258	6.8	---	---	---	11	307	4.5	19	267	9.5
5,000	22	281	7.4	18	296	7.0	17	257	7.9	---	---	---	---	---	---	15	275	10.7
6,000	20	283	9.1	17	289	6.4	14	275	7.6	---	---	---	---	---	---	11	283	12.6
8,000	12	296	11.3	16	281	7.1	---	---	---	---	---	---	---	---	---	---	---	---
10,000	---	---	---	10	292	6.4	---	---	---	---	---	---	---	---	---	---	---	---
12,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	223	0.7	25	113	1.0	31	307	1.3	30	68	4.0	29	123	1.9	29	165	0.6	31	172	1.0
500	---	---	---	25	135	1.2	31	316	1.3	30	75	6.2	29	131	2.5	29	174	1.6	31	242	1.7
1,000	31	225	.5	24	263	.3	31	301	.6	30	75	5.4	24	131	2.3	27	180	2.8	29	282	3.0
1,500	31	272	.8	23	234	1.7	30	227	.7	29	71	4.4	22	168	1.3	24	200	4.3	26	287	3.3
2,000	31	271	2.0	21	233	4.3	29	313	.6	27	73	2.6	18	163	1.1	21	217	4.9	24	296	4.6
2,500	30	274	2.2	20	235	5.7	26	347	2.1	26	66	2.3	13	221	2.2	20	232	5.7	20	288	5.9
3,000	29	299	2.0	19	241	6.7	25	318	4.0	24	67	2.6	12	237	2.5	16	244	6.6	18	277	6.1
4,000	27	310	3.9	13	249	8.1	20	300	4.7	17	28	2.4	---	---	---	14	248	8.0	16	276	7.9
5,000	25	309	6.9	11	258	7.1	19	300	7.8	12	4	2.3	---	---	---	11	260	9.2	---	---	---
6,000	24	313	6.7	---	---	---	16	283	8.1	11	340	4.5	---	---	---	---	---	---	---	---	---
8,000	18	329	8.3	---	---	---	13	277	14.9	10	316	7.3	---	---	---	---	---	---	---	---	---
10,000	12	342	12.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12,000	10	323	7.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	277	4.2	29	165	3.3	30	206	2.5	31	221	0.7	28	289	2.0	28	240	3.4
500	31	331	2.7	29	170	3.7	30	204	3.4	31	226	.8	---	---	---	28	241	4.5
1,000	31	336	2.3	29	182	3.4	30	207	4.5	31	213	1.0	28	289	1.9	28	239	5.4
1,500	30	326	2.5	28	201	3.0	29	232	6.0	31	186	.6	28	279	3.4	25	250	8.0
2,000	30	333	3.0	26	232	2.8	27	244	8.0	31	206	1.0	25	267	5.7	21	252	11.5
2,500	30	324	3.4	25	245	4.8	25	255	9.4	30	235	.7	24	269	7.5	19	253	12.6
3,000	29	326	4.1	23	257	4.7	25	260	9.6	29	236	1.7	24	272	9.4	18	260	13.4
4,000	28	330	5.0	21	269	6.2	22	269	12.0	24	289	2.1	20	276	11.6	17	263	16.9
5,000	26	330	5.9	20	267	6.9	20	268	12.6	21	304	4.6	13	285	13.5	14	274	19.4
6,000	22	325	5.2	19	259	8.9	20	268	14.4	20	292	6.3	10	272	15.6	13	278	18.9
8,000	18	298	4.2	15	267	8.3	16	264	17.0	19	271	7.6	---	---	---	---	---	---
10,000	11	241	1.7	---	---	---	---	---	---	14	280	8.9	---	---	---	---	---	---
12,000	---	---	---	---	---	---	---	---	---	11	270	13.1	---	---	---	---	---	---

Altitude (meters) m. s. l.	St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	29	180	1.3	30	75	1.3	30	270	3.6	28	237	2.2	28	259	1.1	30	231	2.3	28	214	1.0
500	29	177	2.2	30	91	1.6	30	259	2.9	28	226	4.2	28	248	1.7	---	---	---	28	263	1.5
1,000	29	211	3.1	30	106	1.8	25	253	1.4	25	240	7.2	23	269	1.8	30	233	3.9	27	261	1.9
1,500	29	234	3.7	27	141	1.1	23	21	.6	22	247	9.3	23	267	2.5	30	249	4.7	26	276	2.9
2,000	26	259	4.2	25	205	1.8	23	19	1.7	20	252	11.0	21	302	3.5	29	259	5.7	24	276	3.9
2,500	24	262	4.6	23	235	3.4	21	31	2.4	17	255	12.4	17	310	5.2	27	280	5.9	22	275	5.0
3,000	23	275	4.4	21	269	4.1	20	360	2.6	17	260	12.6	15	309	8.0	24	296	6.7	22	273	6.8
4,000	20	260	4.2	19	261	6.1	17	326	3.3	15	261	14.3	14	304	12.3	22	293	8.9	18	268	8.0
5,000	19	273	7.3	15	262	10.2	12	317	3.7	12	264	14.7	11	317	15.1	17	302	13.4	16	267	10.6
6,000	16	275	7.8	10	263	10.6	12	316	5.6	---	---	---	---	---	---	11	293	15.2	14	278	8.9
8,000	14	269	11.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T. during October 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.) Observations	Direction	Speed	Big Spring, Tex. (774 m.) Observations	Direction	Speed	Bismarck, N. Dak. (305 m.) Observations	Direction	Speed	Brownsville, Tex. (7 m.) Observations	Direction	Speed	Caribou, Maine (191 m.) Observations	Direction	Speed
Surface	31	134	2.2	31	150	2.7	30	283	0.8	31	66	1.0	31	238	2.3
500	---	---	---	---	---	---	---	---	---	30	97	3.5	31	255	6.0
1,000	---	---	---	31	156	4.6	30	269	4.4	30	109	3.0	31	271	8.0
1,500	---	---	---	31	179	4.4	30	274	5.6	29	153	2.3	31	270	8.6
2,000	31	209	4.0	31	211	3.8	30	274	7.0	29	171	1.7	31	273	9.2
2,500	31	227	4.1	31	232	3.5	30	274	8.6	30	181	1.4	31	269	11.1
3,000	31	248	4.4	31	243	4.6	30	275	10.3	28	212	1.3	31	266	12.6
4,000	31	261	5.4	31	251	5.8	29	274	14.6	27	240	2.1	31	268	15.3
5,000	30	263	6.4	29	254	8.7	28	271	15.6	28	243	4.7	31	268	16.6
6,000	27	281	6.7	29	252	10.1	27	270	17.6	27	241	6.2	30	267	20.1
8,000	23	269	8.3	27	241	14.1	22	253	21.0	29	242	9.7	27	274	20.0
10,000	18	294	10.5	20	254	17.1	14	244	21.1	26	238	11.8	22	271	24.4
12,000	12	305	11.4	17	254	22.0	13	243	21.4	23	256	12.1	14	280	23.8
14,000	---	---	---	11	253	18.6	---	---	---	20	248	10.7	11	281	24.9
16,000	---	---	---	11	255	13.0	---	---	---	10	205	6.5	---	---	---
18,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Charleston, S. C. (13 m.) Observations	Direction	Speed	Columbia, Mo. (237 m.) Observations	Direction	Speed	Grand Junction, Colo. (1,473 m.) Observations	Direction	Speed	Greensboro, N. C. (275 m.) Observations	Direction	Speed
Surface	31	49	1.4	30	124	1.8	31	18	0.2	31	62	1.5
500	31	83	4.8	30	169	4.4	---	---	---	31	107	2.2
1,000	31	94	4.3	30	195	4.7	---	---	---	31	167	2.8
1,500	31	100	2.6	30	222	3.8	31	27	.2	31	199	2.7
2,000	31	87	1.4	29	241	3.4	31	228	1.4	30	215	2.4
2,500	30	11	.7	29	245	3.9	31	233	2.6	30	235	2.1
3,000	30	300	1.1	29	249	4.8	31	241	3.6	30	254	2.6
4,000	29	246	1.5	28	246	6.3	31	251	5.4	30	257	5.0
5,000	29	259	3.0	27	245	8.1	31	260	5.8	30	261	6.2
6,000	29	268	3.9	26	246	10.5	30	273	7.9	30	261	8.2
8,000	27	268	6.7	25	252	12.3	25	313	10.3	29	263	12.0
10,000	26	292	9.0	23	243	22.7	19	294	8.6	25	273	14.3
12,000	24	286	13.1	19	245	26.2	18	264	12.6	21	287	19.3
14,000	21	285	12.1	12	252	23.4	15	269	14.5	16	285	16.1
16,000	18	276	7.6	---	---	---	---	---	---	---	---	---
18,000	12	8	2.4	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Hatteras, N. C. (3 m.) Observations	Direction	Speed	International Falls, Minn. (358 m.) Observations	Direction	Speed	Little Rock, Ark. (80 m.) Observations	Direction	Speed	Medford, Oreg. (401 m.) Observations	Direction	Speed
Surface	31	356	2.6	31	218	2.0	31	88	1.1	31	275	0.7
500	31	61	3.6	31	220	3.6	31	115	3.7	31	295	1.0
1,000	31	73	3.3	31	241	7.9	31	146	3.2	31	326	1.5
1,500	31	86	1.9	29	258	9.2	31	172	4.3	31	336	1.3
2,000	30	49	1.3	29	265	9.6	30	206	5.8	31	329	1.9
2,500	30	286	.6	28	269	10.8	30	218	7.3	30	322	3.6
3,000	30	275	1.5	27	270	11.9	30	226	7.9	29	321	5.2
4,000	30	297	2.4	25	269	15.9	29	232	8.6	28	315	7.4
5,000	30	286	4.4	23	267	19.9	28	243	9.1	26	317	9.4
6,000	30	279	5.9	21	268	20.7	28	245	11.0	25	315	11.7
8,000	27	285	6.9	18	266	24.6	28	238	17.1	19	292	13.1
10,000	26	295	11.0	14	270	25.5	26	242	19.9	13	302	12.0
12,000	20	311	13.7	10	268	31.8	19	245	24.0	11	286	13.8
14,000	14	314	14.0	---	---	---	---	---	---	---	---	---
16,000	11	318	8.9	---	---	---	---	---	---	---	---	---
18,000	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Miami, Fla. (12 m.) Observations	Direction	Speed	Nantucket, Mass. (14 m.) Observations	Direction	Speed	Nashville, Tenn. (180 m.) Observations	Direction	Speed	New Orleans, La. (6 m.) Observations	Direction	Speed	Oakland, Calif. (8 m.) Observations	Direction	Speed
Surface	31	51	2.2	31	74	0.6	31	124	1.0	31	102	2.0	31	304	2.5
500	30	81	6.9	31	300	1.7	31	148	3.5	31	118	5.2	31	322	3.4
1,000	30	83	7.0	31	316	3.2	31	166	4.1	31	129	4.4	31	334	2.9
1,500	30	85	5.7	31	296	3.3	31	196	4.3	31	143	4.1	31	348	3.1
2,000	30	91	4.8	31	287	4.8	31	218	5.4	31	162	3.8	31	353	3.2
2,500	31	92	4.1	31	277	5.4	31	223	6.7	31	183	2.6	31	349	3.4
3,000	31	92	3.4	31	277	6.6	31	229	7.6	31	204	3.8	31	343	3.7
4,000	31	89	2.7	29	275	7.7	31	241	9.2	30	236	5.3	30	332	5.6
5,000	31	84	1.8	29	266	8.5	31	245	10.2	28	244	6.5	30	326	7.7
6,000	31	34	1.6	28	273	9.4	31	243	10.5	27	249	6.9	30	322	9.2
8,000	30	311	2.9	21	266	11.2	29	253	14.6	27	263	10.6	27	321	10.1
10,000	30	337	5.0	14	247	12.8	29	258	22.3	26	263	15.0	22	315	9.5
12,000	29	328	8.5	---	---	---	22	257	24.3	23	260	18.1	14	285	8.1
14,000	25	335	10.0	---	---	---	18	259	21.6	17	276	13.3	---	---	---
16,000	12	14	9.6	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Oklahoma City, Okla. (392 m.) Observations	Direction	Speed	Rapid City, S. Dak. (980 m.) Observations	Direction	Speed	San Antonio, Tex. (242 m.) Observations	Direction	Speed	San Juan, P. R. (28 m.) Observations	Direction	Speed
Surface	29	141	4.0	31	297	1.1	31	74	2.8	31	143	1.1
500	20	126	3.4	---	---	---	31	93	4.5	31	107	4.3
1,000	19	156	2.9	31	301	1.1	31	110	4.3	31	100	4.5
1,500	23	205	2.1	31	294	4.7	31	131	2.2	30	92	4.1
2,000	24	228	3.6	30	288	5.5	31	179	1.6	30	99	4.2
2,500	25	229	4.1	29	284	6.5	31	220	2.0	30	102	3.7
3,000	24	232	5.3	29	279	8.9	31	241	3.1	29	105	3.8
4,000	25	255	6.4	29	278	11.7	31	249	6.0	30	100	3.5
5,000	26	245	8.8	28	266	12.0	30	256	8.3	30	109	2.2
6,000	26	254	9.7	28	266	13.0	29	251	12.6	30	123	2.4
8,000	26	249	12.6	24	254	16.6	28	247	19.1	30	185	3.1
10,000	24	252	16.4	21	252	15.4	25	247	25.9	30	213	3.5
12,000	18	246	19.7	16	265	18.3	18	242	27.8	30	248	6.9
14,000	11	247	20.1	13	271	18.2	10	238	23.1	29	255	7.2
16,000	---	---	---	---	---	---	---	---	---	15	297	2.5

Altitude (meters) m. s. l.	St. Cloud, Minn. (318 m.) Observations	Direction	Speed	Santa Maria, Calif. (72 m.) Observations	Direction	Speed	Sault Ste. Marie, Mich. (221 m.) Observations	Direction	Speed	Spokane, Wash. (726 m.) Observations	Direction	Speed
Surface	31	191	0.8	31	273	0.7	31	197	0.4	30	189	1.9
500	31	201	2.4	30	335	3.3	31	208	3.7	---	---	---
1,000	30	238	6.4	31	351	3.7	31	235	7.7	29	229	3.5
1,500	30	245	8.8	30	7	3.2	31	248	9.7	29	255	4.4
2,000	28	251	9.5	30	359	3.3	29	258	9.9	29	269	4.4
2,500	28	254	10.8	30	353	3.4	28	260	10.9	30	288	5.3
3,000	29	254	12.5	30	344	3.5	27	253	11.8	30	290	6.6
4,000	27	256	14.0	30	337	5.0	25	257	14.8	30	294	9.5
5,000	24	254	14.1	30	324	6.3	24	258	18.2	30	292	11.7
6,000	24	255	15.8	29	320	7.5	18	264	15.1	28	282	14.9
8,000	20	265	17.9	26	320	5.5	16	274	20.2	22	279	15.5
10,000	19	258	19.7	26	318	8.9	11	285	23.2	15	324	13.3
12,000	15	254	20.7	22	297	9.0	---	---	---	---	---	---
14,000	12	248	19.0	19	286	12.5	---	---	---	---	---	---
16,000	---	---	---	13	280	8.7	---	---	---	---	---	---

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.) Observations	Direction	Speed	Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.) Observations	Direction	Speed
Surface	29	77	1.2	3,000	26	290	7.4
500	28	220	1.7	4,500	27	297	10.0
1,000	27	265	2.9	5,000	26	294	12.1
1,500	27	289	3.9	6,000	25	293	14.5
2,000	26	295	4.6	8,000	20	307	19.0
2,500	26	294	5.4	10,000	12	301	19.4

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following Table III in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR OCTOBER 1949

Most of the flooding during October was minor and light in intensity but it was much more extensive than one year ago. The flash floods in southwestern Missouri on the James River were very destructive and were comparable to the great flood of 1909.

Atlantic Slope drainage.—Precipitation in the North Atlantic States was mostly below normal with streams remaining low throughout the month.

Heavy rains in the upper portions of the Cape Fear Basin in North Carolina on the 7th and 8th caused minor flooding at Moncure and Elizabethtown, but no damage resulted from the overflows. This same storm also caused heavy rains over the upper Saluda and Broad Rivers in South Carolina and moderate flooding with considerable damage at Greenville and vicinity on the Reedy River, a tributary of the Saluda.

East Gulf of Mexico drainage.—Heavy rains during the last two days of October in the upper reaches of the Warrior, Tombigbee, and Oostanaula Rivers caused sharp rises in these streams but no flooding resulted. The Oostanaula at Resaca, Ga., rose 12.8 feet during the 24-hour period ending at 7 a. m. on the 31st with a crest stage of 19.4 feet on November 2d.

Upper Mississippi Basin.—Light flooding occurred along the Bourbeuse and Meramec Rivers due to the heavy rains on the 5th, 6th, 11th, and 12th. Precipitation during that period averaged over 5 inches. Additional rains of nearly 2 inches occurred during the 24-hour period ending at 7 a. m. on the 20th.

Missouri Basin.—Light to locally moderate overflows occurred on the upper Solomon in the vicinity of Beloit, Kans., from the 10th to the 12th and along the lower Marais des Cygnes from Osawatomie to below LaCygne, Kans., from the 21st to the 23rd. The flooding in the upper Solomon was due to heavy rains averaging about 2 inches and in the Marais des Cygnes to rains averaging around 4 inches during the period from the 19th to the 21st. Flood damages were very light.

Flash floods occurred in southwestern Missouri in the Springfield area on the 21st due to heavy rains. During the 6-hour period ending at 7 a. m., 3.25 inches of rain occurred in the area with more than 5 inches occurring during the storm. Residents around Turner Station compared the high waters from the James River to the great flood of 1909, and thought it just as high or higher. Railroad tracks and roads in the area were covered with water up to 5 feet. Considerable damage resulted to roads, grain in fields, and in the loss of stock.

Ohio Basin.—Heavy rains beginning on the 11th over the Wabash Basin resulted in some flooding from Wabash to Terre Haute, Ind., between the 12th and 14th. Some damage resulted to soybeans in the fields that had not yet been combined, and the corn harvest was considerably delayed. Locally heavy rains on the 21st and 22d produced minor flooding on the West Fork of the White River at Edwardsport, Ind., on the 23rd.

Light to moderate rains over the Tennessee Basin beginning on the 25th, with heavy rains on the 30th, caused flooding on the South Chickamauga Creek near Chattanooga, Tenn., from the 30th to Nov. 2d, and near flood stages on several headwater streams and creeks. The Tellico River above Tellico Plains also exceeded bankfull stages at several points. Scattered flooding of corn in the field occurred above this stream but damages were negligible.

White, Arkansas, and Red Basins.—The Black River at Black Rock, Ark., approached within 0.2 foot of flood stage on the 7th. Another slight rise on the 13th brought the river to within 0.5 foot of flood stage. The lower White River remained within a few feet of bankfull stage during the last half of the month. It reached within 0.5 foot of flood stage at Clarendon, Ark., on the 31st.

Minor flooding occurred on the Arkansas River at Great Bend, Kans., due to heavy rain averaging about 2 inches during the 24-hour period ending on the morning of the 10th. Heavy rains (2 to 6 inches) from the 19th through the 21st along the lower Cottonwood and upper Neosho Rivers caused these streams to rise to one-half to three-quarters bankfull.

Flooding occurred on the Sulphur River on two different occasions. The first was minor and was due to a series of rains. Damage from this flood was light. The second and more severe flood was due to heavy rains at and below Hagansport, Tex., on the 21st and additional heavy rains on the 23rd. The flooding on the Cypress River was the result of the heavy rains ranging from 3 to 5 inches on the 21st and 24th.

Lower Mississippi and Atchafalaya Basins.—Five inches of rain fell over the St. Francis Basin from the 3rd to the 6th, saturating the ground thoroughly and filling the reservoir and river beds. No flooding occurred until after the rains (2 inches) on the 12th. Light rain (less than an inch) occurred on the 22d and caused another rise to above bankfull stage at Fisk, Mo., and St. Francis, Ark.

Light flooding occurred on the Atchafalaya at Morgan City, La., for a few hours on the 4th and 5th due to wind and tide effect.

West Gulf of Mexico drainage.—Heavy rains occurred between the 2d and 5th in connection with the hurricane that moved inland on the Texas coast. The rainfall averaged over 5 inches over the lower and middle Sabine Basins. All streams in the area rose rapidly but no flooding occurred. Heavy rains (over 4 inches) occurred over the upper Sabine River Basin from the 21st to the 25th, causing the river to rise to above flood stage at Mineola and Gladewater, Tex.

Excessive rains occurred in the lower Trinity River in connection with the inland movement of the hurricane on the 3d and 4th, causing light flooding at Liberty, Tex. The rainfall at this point exceeded 10 inches during the storm. An additional 5 inches of rain on the 7–8th caused further rise at Liberty to a crest of 26.6 feet on the 10th. Another flood occurred at this point during the last 6 days of October due to additional heavy rain. Considerable damage resulted to county roads, bridges, and to the rice crops.

Moderately heavy rains over the middle portion of the Guadalupe River on the 22d and 23d caused moderate flooding at Gonzales, Tex., on the 23d and 24th. Additional moderately heavy rains on the morning of the 24th caused another rise to above bankfull stage at Gonzales on the 25th. Only minor damage was reported. Considerable flooding occurred in the small creeks of the San Antonio River due to the heavy rain (2 inches) on the 24th. Approximately 13.4 feet of water backed up behind the Olmos Creek dam. Two persons were drowned when they tried to cross a flooded creek in a small crude boat. Considerable damage was done to streets and bridges. No flooding occurred downstream.

Puget Sound and Washington Coast drainage.—Light flooding occurred on the Snohomish River at Snohomish, Wash., and on the Snoqualmie River at Tolt, Wash., due to heavy rains early on the 28th. Some low farmland along these streams was flooded. Low sections of U. S. Highway 10 between Monroe and Snohomish and on State Highway 1-A south of Snohomish were inundated.

FLOOD STAGE REPORT FOR OCTOBER 1949

[All dates in October unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
Cape Fear:	*Feet*			*Feet*	
Moncure, N. C	20	8	8	20.1	8
Lock No. 2, Elizabethtown, N. C	20	9	11	22.8	10
Saluda: Pelzer, S. C	6	7	11	15.0	8
		31	Nov. 3	8.0	Nov. 2
Broad:					
Gaffney, S. C	10	7	8	11.0	7
Blairs, S. C	14	8	10	21.8	9
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Bourbeuse: Union, Mo	15	8	8	16.0	8
		13	14	20.1	14
		21	24	15.6	22, 24
Meramec:					
Steelville, Mo	12	7	7	12.6	7
		12	12	13.2	12
		22	22	15.4	22
Sullivan, Mo	11	6	7	12.8	6
		13	13	12.8	13
		22	23	14.8	23
Pacific, Mo	11	6	9	16.5	9
		11	15	17.8	15
		20	25	14.0	20
				17.6	25
Valley Park, Mo	14	7	9	14.7	8
		13	16	16.1	15
		20	20	15.1	20
		22	25	17.5	24
Missouri Basin					
Solomon: Beloit, Kans	18	10	12	23.1	11
Big Blue: Kansas City, Mo. (Bannister Road)	21	21	21	30.1	21
Lamine: Clifton City, Mo	15	21	22	21.7	22
Blackwater: Blue Lick, Mo	25	21	26	32.0	23
Petit Saline: Boonville, Mo	17	22	22	22.2	22
Moreau: Jefferson City, Mo	20	22	22	22.5	22
Marais des Cygnes:					
Osawatomie, Kans	28	21	22	28.9	22
LaCygne, Kans	25	22	23	28.0	23
Osage: Lakeside (Bagnell Dam), Mo	60	27	28	60.2	27
Gasconade: Jerome, Mo	15	11	14	17.2	11
		24	24	19.0	24

FLOOD STAGE REPORT FOR OCTOBER 1949—Continued

[All dates in October unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
Ohio Basin					
	Feet			*Feet*	
West Fork: Edwardsport, Ind	12	23	24	13.2	23
Wabash:					
Wabash, Ind	12	12	12	12.9	12
Lafayette, Ind	11	13	14	12.5	13
Terre Haute, Ind	14	13	14	14.2	13-14
South Chickamauga Creek: Chickamauga, Tenn	10	30	Nov. 2	14.0	31
Arkansas Basin					
Arkansas: Great Bend, Kans	8	11	12	8.8	12
Red Basin					
Sulphur:					
Hagansport, Tex	38	10	11	38.6	10
		25	28	39.8	25
Naples, Tex	22	12	16	24.6	14
		25	Nov. 3	29.4	28
McCartney Bridge, Tex	22	29	Nov. 7	26.2	Nov. 1
Cypress: Jefferson, Tex	18	29	Nov. 2	22.6	30
Lower Mississippi Basin					
St. Francis:					
Fisk, Mo	20	14	16	21.1	15
		24	28	22.3	25
St. Francis, Ark	18	19	21	18.2	20
		30	Nov. 1	18.2	31
Atchafalaya Basin					
Atchafalaya: Morgan City, La	6	4	4	6.2	4
		5	5		
WEST GULF OF MEXICO DRAINAGE					
Sabine:					
Mineola, Tex	14	25	31	17.4	29
Gladewater, Tex	26	30	([2])		
Elm Fork: Carrollton, Tex	6	24	26	8.6	25
East Fork: Rockwall, Tex	10	24	28	13.9	27
Trinity:					
Dallas, Tex	28	24	28	34.4	26
Rosser, Tex	26	29	31	28.2	30
Trinidad, Tex	28	Nov. 1	Nov. 2	28.8	Nov. 1
Guadalupe:					
Gonzales, Tex	21	23	24	29.1	23
		26	26	24.3	26
Victoria, Tex	21	26	29	24.4	28
PACIFIC SLOPE DRAINAGE					
Puget Sound					
Snoqualmie: Tolt (nr.), Wash	51.5	28	28	51.7	28
Snohomish: Snohomish, Wash	23.6	28	28	23.8	28

[1] Provisional.
[2] Continued at end of month.

CLIMATOLOGICAL DATA FOR OCTOBER 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	70.2	+5.4	Selma	92	13	3 stations	37	[1] 27	3.37	+0.47	Guntersville	10.54	Newton	0.63
Arizona	59.0	−2.2	Parker	104	3	Fort Valley	−9	21	1.15	+.26	Junipine	6.12	Safford	.08
Arkansas	62.8	.0	2 stations	91	11	2 stations	23	31	8.50	+5.25	Augusta	14.92	Denver	2.66
California	59.3	−1.9	Brawley	106	1	Gem Lake	8	19	.27	−.82	Gasquet R. S.	5.24	121 stations	.00
Colorado	45.8	−1.2	Eversoll Ranch	94	3	2 stations	−5	[1] 21	1.24	+.04	Steamboat Springs	3.12	San Luis Lakes	.10
Florida	76.8	+3.8	2 stations	94	[1] 6	Pensacola WB City	43	31	3.72	−.43	Homestead Experimental Station.	13.61	Grape Hammock 3 W.	.25
Georgia	69.9	+4.6	Quitman	92	[1] 6	Blairsville Experimental Station.	32	1	3.07	+.35	Flat Top	13.54	Mount Vernon	.40
Idaho	42.5	−4.9	Burley	86	5	Obsidian, 4 NNE	6	9	1.53	+.11	Roland W. Portal	4.30	Grand View	.01
Illinois	58.8	+2.9	Henry	91	9	3 stations	21	31	5.17	+2.50	Du Quoin	10.53	Illinois City Dam 16	1.23
Indiana	59.2	+4.0	Plymouth Power Station.	93	8	Elwood Water Works	21	27	4.89	9+2.12	Frankfort Disposal Plant.	8.66	Moores Hill	1.51
Iowa	55.5	+3.0	Knoxville	92	9	Spencer	10	31	1.93	−.36	State Center	3.91	Sac City	.72
Kansas	58.1	+.8	Lincoln	95	7	2 stations	17	31	2.42	+.50	Lebo	8.61	Great Bend	.65
Kentucky	61.8	+3.3	2 stations	89	[1] 7	Paducah No. 5 Fire Station.	25	31	4.53	+1.87	Clinton	8.94	Headquarters	1.25
Louisiana	71.4	+2.8	Angola	94	10	Monroe CAA	34	31	7.30	+4.03	Keithville	16.60	Pearl River	1.83
Maryland-Delaware	61.0	+4.5	Coleman, Md	97	[1] 9	Oakland, Md	18	27	3.57	+.52	Milford, Del	5.86	Luke, Md	2.37
Michigan	53.2	+4.4	Wayne	91	9	Cadillac, CAA	14	25	2.49	−.17	Detroit WB Airport	5.50	Michigamme	.68
Minnesota	48.1	+1.4	2 stations	83	[1] 3	2 stations	10	26	3.24	+1.39	Duluth WB Airport	7.53	Harmony	.54
Mississippi	69.2	+3.6	Eupora	94	9	Philadelphia 1 WSW	29	31	4.75	+2.17	Rosedale	12.30	Heidelburg	.66
Missouri	59.3	+1.4	Brunswick	93	8	2 stations	17	31	6.09	+3.15	Rolla	13.67	Bethany	1.93
Montana	41.0	−4.3	Crow Agency	83	15	do	2	19	1.34	+.33	Heron 2 SW	3.54	Deer Lodge	.21
Nebraska	52.3	+.3	Weeping Water	91	8	Loup City	12	31	1.70	+.23	Gordon	3.63	Broken Bow	.30
Nevada	49.5	−1.7	Lathrop Wells	104	1	Lehman Caves, Nat'l Mon.	3	20	.40	−.25	Jarbidge	2.98	12 stations	.00
New England	53.5	+3.9	Waterbury, Conn	91	10	Prentiss, Maine	14	25	2.29	−1.14	Chatham, Mass	4.40	Fort Adams, R. I	.74
New Jersey	59.9	+5.2	Rutherford	94	10	3 stations	20	28	2.49	−1.13	Atlantic City	5.57	Lakehurst	1.06
New Mexico	53.0	−1.8	Jal	95	10	do	7	[1] 21	.68	−.45	Cloudcroft No. 2	3.15	13 stations	.00
New York	54.8	+4.6	Dansville	93	11	Saranac Lake	14	25	1.79	−1.49	Peekamoose	4.20	Canisteo	.51
North Carolina	64.6	+4.4	5 stations	88	[1] 9	Transou	29	[1] 1	4.10	+.89	Cedar Mountain	13.44	Willard Experimental Station.	T
North Dakota	43.5	−.7	Fort Yates	91	5	2 stations	8	[1] 24	2.55	+1.52	Cavalier power plant	6.02	Grenora	.43
Ohio	59.1	+5.3	Hillsboro 1 E	92	9	Mansfield 6 W	16	27	1.68	−.83	Wauseon	5.12	Ashland	.50
Oklahoma	61.8	−.8	Alva	97	7	Kenton	18	31	3.57	+.61	Flashman Tower	10.46	Kenton	.16
Oregon	45.6	−4.7	Powers	87	30	The Poplars	5	16	1.89	−.33	Timberline Lodge	11.01	Grizzly	T
Pennsylvania	57.0	+4.3	Wellsboro	95	11	Kane 1 NNE	16	27	2.29	−.93	Kregar 4 SE	4.30	Beaver Falls	.57
South Carolina	67.8	+3.6	Yemassee	90	7	Union 7 SW	36	1	3.51	+.61	Sassafras Mountain	13.19	Summerville 2 WNW	.41
South Dakota	48.3	−.6	2 stations	93	5	Deerfield Dam	5	21	2.15	+.94	Murdo	4.50	Hot Springs	.60
Tennessee	64.1	+4.2	3 stations	90	[1] 9	Gatlinburg 2 SW	30	[1] 1	6.61	+3.76	Copper Hill Substation.	13.84	Mountain City	2.59
Texas	66.0	−1.7	Pecos	102	9	Dalhart Experimental Station.	21	31	5.56	+2.87	Splendora	25.34	4 stations	.00
Utah	47.0	−2.7	St. George P. H	94	[1] 3	Bryce Canyon CAA-AP.	2	21	1.89	+.71	WBES Rice (storage)	7.72	Callao	.05
Virginia	61.2	+3.7	5 stations	89	[1] 9	Burkes Garden	25	[1] 27	3.38	+.39	Dante	7.08	Smithfield	1.43
Washington	45.9	−4.2	Longview	80	[1] 2	Bumping Lake	10	19	2.96	−.05	Snoqualmie Pass	13.81	2 stations	.05
West Virginia	59.9	+5.1	Morgantown No. 1	95	10	Canaan Valley	16	27	2.99	+.17	Kayford	5.99	New Cumberland	.90
Wisconsin	52.2	+3.7	Richland Center	87	8	Danbury	14	31	1.80	−.56	Superior Bong AP	5.80	Cashton	.45
Wyoming	40.7	−3.6	La Grange	89	5	Kaycee	−3	21	1.85	+.72	Bedford	4.02	Pine Bluffs	.61
Alaska														
Hawaii	73.0	−1.1	Puunene CAA	91	[1] 19	Haleakala RS	37	15	3.51	−2.41	Makahanaloa	21.00	11 stations	.00
Puerto Rico	77.9	−.5	Caguas (3)	95	11	Utuado	54	3	7.24	−.65	San Lorenzo (Espino)	16.47	Ponce	2.40

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR OCTOBER 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Speed of fastest mile: Miles per hour	Speed of fastest mile: Direction	Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
NEW ENGLAND									53.2	+4.7							76	2.27	−1.3														5.7	
Caribou [2]	628	5	33	997.0	1,020.5	-----	58	36	46.7	+5.2	76	12	20	25	569	37	73	2.35	−1.2	0.66	9	2	T	0	11.9	ssw.	37	wsw.	12	9	7	15	6.1	--
Eastport	75	67	82	1,018.3	1,021.0	+5.1	58	45	51.3	+3.8	68	10	30	25	426	----	--	1.82	−1.7	.71	9	0	.0	0	9.2	-----	36	s.	22	12	7	12	5.3	62
Portland, Me [2]	103	6	43	1,017.3	1,021.7	+4.4	64	40	51.6	+2.9	81	10	22	25	419	45	80	2.26	−.9	.88	8	0	.0	0	5.4	s.	28	se.	26	11	10	10	5.3	66
Concord [2]	289	5	45	1,011.2	1,022.3	+5.0	66	37	51.6	+3.8	84	10	21	28	427	42	75	2.07	−.8	.96	8	0	.0	0	3.8	nw.	27	w.	31	10	10	11	5.4	48
Mt. Washington	6,274	5	37	811.0	1,026.1	-----	42	29	35.2	+5.5	57	11	7	27	923	----	--	5.16	−1.1	.90	12	0	4.3	0	28.2	-----	--	-----	--	9	9	13	5.7	51
Burlington [2]	403	6	51	1,005.8	1,021.1	+4.2	65	41	53.2	+4.0	85	11	22	25	378	45	75	1.46	−1.5	.39	8	0	.0	0	8.9	s.	44	s.	22	7	15	9	5.4	54
Boston [2]	124	33	62	1,017.3	1,022.2	+4.9	66	50	58.4	+4.8	86	10	37	25	230	46	68	1.60	−1.6	.90	6	0	.0	0	10.8	sw.	35	sw.	12	12	5	14	5.5	68
Nantucket [2]	12	4	34	1,021.3	1,022.2	+4.6	63	49	55.8	+1.6	72	10	37	27	287	52	84	3.23	−.2	1.31	10	0	.0	0	10.4	sw.	34	ne	16	11	4	16	6.2	52
Block Island	26	11	46	1,020.7	1,021.7	+4.1	64	56	60.0	+5.1	76	10	44	27	191	----	--	.92	−2.6	.64	8	0	.0	0	15.1	-----	56	ne.	18	9	8	14	5.7	52
Providence [3]	159	65	60	1,015.9	1,022.2	+4.6	68	49	58.6	+6.4	90	10	38	25	231	47	74	1.98	−1.1	1.14	4	0	.0	0	8.0	sw.	28	sw.	12	11	6	14	5.6	62
Hartford [2]	159	5	44	1,015.9	1,022.4	+4.4	70	46	57.9	+6.7	89	10	29	28	257	48	75	2.06	−1.5	.97	10	0	.0	0	6.8	s.	29	s.	12	11	5	15	6.0	58
New Haven [2]	107	5	39	1,018.0	1,021.7	+3.4	68	49	58.1	+6.3	81	11	33	28	241	----	--	2.30	−1.0	1.56	8	1	.0	0	6.8	-----	26	ne.	18	11	5	15	5.9	62
MIDDLE ATLANTIC									61.5	+5.3							74	2.80	−.2														6.1	
Albany [2]	97	6	40	1,017.3	1,022.6	+5.0	67	43	54.8	+5.5	86	10	25	25	343	46	76	1.95	−.5	.82	11	0	.0	0	6.9	s.	40	nw.	12	9	10	12	5.6	56
Binghamton [4]	871	57	79	990.9	1,022.3	+4.0	67	44	55.6	+5.6	88	10	29	25	315	46	78	1.94	−1.0	.54	9	0	.0	0	4.7	sw.	20	sw.	22	7	11	13	6.2	54
New York [4]	314	415	454	1,010.5	1,022.2	+4.2	70	56	62.8	+6.5	88	10	41	28	123	50	66	2.03	−1.5	1.20	9	0	.0	0	10.9	nne.	38	sw.	12	9	8	14	6.2	48
Allentown [2]	385	4	58	1,007.8	1,022.6	-----	69	47	58.4	+5.4	89	10	27	28	239	49	75	2.29	−1.0	.90	12	0	.0	0	6.1	ene.	--	-----	--	11	5	15	5.9	--
Harrisburg [2]	374	30	49	1,008.5	1,022.4	+3.4	69	50	60.0	+5.2	88	10	33	28	201	49	72	2.67	−.3	.84	11	0	.0	0	4.7	ese.	23	sw.	22	11	3	17	6.3	47
Philadelphia [4]	114	174	150	1,016.3	1,022.1	+3.1	70	56	62.9	+5.1	85	11	43	28	118	51	73	2.59	−.2	1.08	9	0	.0	0	8.3	sw.	26	ssw.	12	9	5	17	6.4	45
Reading	323	47	306	1,009.8	1,021.7	+2.7	70	52	61.2	+5.8	89	10	33	28	166	----	--	2.56	−.6	1.06	11	0	.0	0	9.0	-----	30	sw.	12	9	6	16	6.2	53
Scranton	805	72	104	992.6	1,021.7	+3.1	68	47	57.7	+5.8	87	10	30	28	259	----	--	1.94	−1.1	.52	9	0	.0	0	5.3	-----	24	nw.	31	13	9	9	4.8	57
Atlantic City	52	37	172	1,019.3	1,021.3	+2.7	67	58	62.6	+4.7	80	10	42	28	117	----	--	5.57	+2.4	2.66	11	0	.0	0	15.8	-----	52	n.	18	10	4	17	6.3	53
Newark [2]	30	5	46	1,020.7	1,022.0	-----	71	52	61.6	+6.0	92	10	32	28	154	49	68	1.59	−2.2	.84	8	0	.0	0	9.5	ne.	28	ene.	18	9	7	15	6.1	--
Trenton	190	89	107	1,014.6	1,021.3	+3.0	69	53	61.1	+5.5	85	10	35	28	167	----	--	2.55	−.2	1.44	9	0	.0	0	8.1	-----	24	sw.	22	8	4	19	6.9	45
Baltimore [4]	123	100	215	1,017.3	1,022.3	+3.7	72	57	64.2	+6.0	87	11	41	28	98	52	73	4.11	+1.2	1.48	9	0	.0	0	6.9	nne.	30	sw.	12	10	5	16	5.9	47
Washington [4]	112	56	100	1,017.6	1,022.1	+3.1	73	55	64.0	+6.6	88	10	39	28	116	52	73	3.21	+.4	1.66	11	0	.0	0	8.9	ssw.	23	nw.	23	11	3	17	5.9	47
Cape Henry	18	8	54	1,020.0	1,020.7	+2.4	72	62	66.6	+4.5	82	12	51	26	42	----	--	2.11	−.9	.79	8	0	.0	0	13.5	-----	42	n.	18	12	4	15	5.8	61
Lynchburg [2]	686	5	58	987.8	1,022.0	+2.7	71	52	61.7	+4.5	84	9	43	28	142	52	76	2.83	−.3	1.07	11	1	.0	0	7.2	ne.	22	w.	22	11	8	12	5.8	51
Norfolk [4]	91	80	125	1,018.0	1,021.7	+2.7	73	60	66.7	+4.2	85	10	52	27	43	58	81	2.29	−.8	.41	8	0	.0	0	10.2	ne.	26	n.	18	10	4	17	6.6	57
Richmond [4]	144	11	52	1,015.6	1,021.9	+2.6	73	55	63.6	+4.0	85	10	43	28	105	55	81	5.36	+2.5	3.53	5	1	.0	0	5.5	n.	20	s.	31	9	7	15	6.2	54
SOUTH ATLANTIC									68.2	+4.6							80	3.90	+.7														6.3	
Asheville	2,253	77	92	947.9	1,021.0	+1.0	70	53	61.6	+6.3	82	9	37	1	141	55	88	5.13	+2.4	1.85	10	0	.0	0	6.6	se.	25	se.	5	3	12	16	7.2	50
Charlotte [4]	779	63	86	992.9	1,021.2	+1.9	74	57	65.8	+4.1	83	22	47	1	58	56	75	6.70	+3.8	2.95	9	0	.0	0	5.5	nne.	19	sw.	31	9	8	14	6.2	56
Greensboro [2]	886	6	56	989.8	1,021.8	+2.2	73	53	62.6	+4.1	83	9	41	21	114	54	77	5.36	+2.3	3.90	8	1	.0	0	7.9	ne.	24	sw.	31	9	6	16	6.2	49
Hatteras	11	5	47	1,019.6	1,020.1	+2.1	74	66	69.8	+3.9	81	10	58	19	9	65	85	2.17	−2.8	1.13	11	4	.0	0	11.2	n.	27	nw.	16	9	5	17	6.5	44
Raleigh [4]	376	5	71	1,005.4	1,021.2	+2.2	75	56	65.6	+3.6	85	9	46	21	57	56	80	3.55	+.7	1.34	8	1	.0	0	5.1	ne.	19	sw.	31	12	8	11	5.3	51
Wilmington	72	73	107	1,019.0	1,020.4	+1.8	77	62	69.4	+4.1	82	13	48	21	13	63	--	2.49	−.8	2.64	6	1	.0	0	8.1	ne.	27	s.	31	11	7	13	5.7	59
Charleston [4]	48	11	92	1,017.3	1,019.2	+.9	77	66	71.3	+3.5	82	30	56	21	0	64	84	1.90	−1.4	.79	6	3	.0	0	10.0	ne.	31	ne.	27	9	5	17	6.4	61
Columbia, S. C. [4]	347	70	91	1,011.9	1,020.1	+1.1	78	59	68.4	+4.1	85	9	50	1	23	60	78	2.00	−.6	1.24	8	2	.0	0	7.4	ne.	24	s.	31	10	3	18	6.4	56
Greenville, S. C. [2]	1,040	18	36	983.4	1,020.5	+1.9	74	58	65.6	+5.4	83	22	49	1	58	57	79	10.40	+7.3	6.33	12	4	.0	0	7.2	ne.	30	n.	6	6	6	19	7.1	50
Augusta [2]	182	62	77	1,013.2	1,019.8	+1.5	80	61	70.3	+4.4	87	13	53	19	10	60	74	3.42	+.8	1.52	9	3	.0	0	7.2	ne.	---	-----	---	6	8	17	6.7	--
Savannah [2]	65	19	51	1,016.9	1,019.1	+1.1	81	64	72.6	+6.9	88	24	54	19	0	65	82	1.23	−1.8	.42	9	2	.0	0	11.4	n.	28	se.	30	6	9	16	5.7	66
Jacksonville [4]	43	86	110	1,016.9	1,018.2	+.9	82	69	75.6	+4.5	88	7	60	21	0	68	79	2.48	−2.0	.71	12	0	.0	0	7.7	ne.	23	ne.	14	4	13	14	----	49
FLORIDA PENINSULA									79.0	+1.8							78	4.19	−1.4														4.8	
Key West [4]	21	10	64	1,014.2	1,014.8	+.9	85	76	80.4	+1.3	88	31	72	10	0	72	78	3.68	−2.3	.89	15	7	.0	0	9.1	ne.	23	e.	9	12	14	5	4.5	74
Miami [4]	25	242	249	1,013.9	1,015.1	+.2	83	74	78.6	+.6	86	26	69	21	0	70	78	7.57	−.2	2.77	16	4	.0	0	14.6	ne.	36	ne.	12	8	19	4	4.7	77
Tampa [2]	35	5	36	1,015.2	1,016.6	+.7	87	69	77.9	+3.6	90	7	62	21	0	69	79	1.32	−1.8	.42	7	9	.0	0	6.4	ne.	22	sw.	31	11	13	7	5.2	62
EAST GULF									71.7	+4.9							80	3.20	+.1														6.8	
Atlanta [2]	1,173	33	72	978.0	1,019.4	+.4	75	59	67.2	+4.5	83	13	48	13	41	58	78	3.10	+.4	1.64	12	3	.0	0	7.8	ene.	28	nw.	31	4	10	17	7.3	43
Macon [2]	370	79	87	1,006.1	1,019.0	+.4	81	60	70.8	-----	91	6	49	24	10	61	76	4.05	------	1.33	9	1	.0	0	6.9	ne.	---	-----	---	5	6	20	7.1	--
Thomasville	273	48	---	-----	-----	-----	----	----	-----	-----	----	--	----	--	----	----	--	----	-----	----	----	----	----	----	----	-----	---	-----	--	--	--	----	----	--
Apalachicola	35	11	51	1,015.9	1,016.9	.0	81	70	75.1	+4.5	86	6	52	31	0	----	--	4.75	+1.6	2.35	9	4	.0	0	8.2	ne.	31	e.	10	12	7	12	5.4	64
Pensacola [4]	56	54	79	1,015.2	1,017.3	.0	81	68	74.7	+4.8	86	6	43	31	7	68	--	2.83	−1.4	1.61	8	2	.0	0	7.4	ene.	32	nw.	31	11	6	14	5.9	69
Anniston	618	6	32	996.6	1,018.9	+.6	79	58	68.2	-----	87	6	42	27	41	60	79	2.23	−.4	1.30	6	4	.0	0	6.4	ene.	---	-----	---	5	14	12	7.4	--
Birmingham [2]	700	5	63	993.6	1,018.8	+.2	78	59	68.8	+6.4	86	13	39	31	39	60	78	3.00	+.6	1.40	14	2	.0	0	7.4	ene.	29	e.	2	3	14	14	7.1	37
Mobile [4]	57	86	161	1,009.1	1,017.2	−.4	82	67	74.6	+5.3	89	9	44	31	13	67	86	1.52	−2.1	.51	9	1	.0	0	8.1	e.	46	nw.	31	6	11	14	6.5	49
Montgomery [4]	218	92	105	1,010.8	1,018.2	−.4	81	63	72.0	+5.4	88	7	42	31	13	62	78	3.13	+.7	1.61	12	4	.0	0	6.5	ene.	23	nw.	31	6	11	14	6.4	53
Meridian [4]	375	67	92	1,004.4	1,018.1	+.1	80	60	70.2	+5.9	89	12	37	31	31	63	82	1.86	−.5	.60	6	2	.0	0	5.6	e.	---	-----	---	7	5	19	7.1	--
Vicksburg [4]	247	82	102	1,008.5	1,017.3	−1.0	76	62	68.8	+2.1	88	10	40	31	46	62	--	4.18	+1.4	1.21	14	3	.0	0	8.3	se.	30	sw.	5	3	9	19	7.7	37
New Orleans C. O	53	76	84	1,014.2	------	-----	82	70	75.9	+4.9	88	10	49	31	10	----	--	3.53	+.2	1.06	11	1	.0	0	6.3	-----	19	e.	1	4	14	13	6.5	40
New Orleans A. P. [3]	30	6	52	1,014.2	1,016.2	−.7	82	67	74.6	-----	89	11	49	31	14	68	82	4.27	------	1.52	9	3	.0	0	8.3	e.	30	nw.	31	7	9	15	6.7	--

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR OCTOBER 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air, Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
WEST GULF	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
									69.8	+0.8							77	8.36	+5.3														6.3	
Shreveport [2]	181	5	64	1,007.5	1,016.6	-1.0	76	59	67.4	+.3	89	10	36	31	81	61	84	14.02	+11.3	6.83	16	2	.0	0	9.0	nne.	34	ne.	4	4	10	17	7.1	44
Fort Smith [2]	463	6	30	1,001.4	1,017.9	+.6	74	52	62.8	.0	87	9	31	31	163	53	74	5.60	+2.6	2.37	10	3	.0	0	7.0	ene.	33	ne.	30	11	3	17	5.9	65
Little Rock [2]	265	26	58	1,014.6	1,018.0	.0	73	56	64.4	+.8	87	8	37	31	115	56	77	9.68	+7.0	4.07	12	1	.0	0	7.1	se.	30	ne.	5	9	6	16	6.3	45
Austin [2]	621	5	41	994.9	1,016.1	-.8	80	60	69.6	+1.3	90	9	40	31	52	59	75	4.38	+1.2	1.94	9	3	.0	0	9.2	n.	36	n.	30	8	11	12	6.2	55
Brownsville [2]	20	5	54	1,011.2	1,013.2	-1.7	84	69	76.9	+2.0	91	11	51	31	8	67	76	.56	-3.0	.27	4	0	.0	0	11.5	se.	30	nw.	30	8	16	7	5.2	46
Corpus Christi [2]	44	6	33	1,013.9	1,014.6	-1.3	83	66	74.3	+3.2	92	4	45	31	18	67	80	6.36	+3.9	2.63	13	7	.0	0	10.3	sse.	40	n.	30	9	9	13	5.6	67
Dallas [2]	488	34	45	999.0	1,016.6	-.3	75	56	65.6	-1.7	88	7	38	31	110	56	74	8.04	+5.3	3.35	10	4	.0	0	8.7	n.	31	n.	30	6	9	16	6.5	39
Forth Worth [2]	706	40	56	992.6	1,016.8	-.1	75	56	65.5	-.2	89	7	37	31	115	55	73	6.50	+3.7	3.44	9	4	.0	0	13.7	sse.	43	sw.	21	8	8	15	5.9	
Galveston [4]	54	122	129	1,014.6	1,015.0	-1.9	78	69	73.4	+.7	85	10	49	31	21	68	84	8.37	+4.0	3.57	15	2	.0	0	13.6	nne.	66	se.	3	8	5	18	6.7	45
Houston [4]	138	157	190	1,012.5	1,015.0	-1.9	78	65	71.8	+1.5	89	10	44	31	32	66	84	17.64	+13.9	7.63	15	5	.0	0	9.7	nne.	70	e.	4	4	6	21	7.6	31
Laredo [2]	418	10	38	999.0	1,013.6		86	65	75.4	+1.7	96	11	47	31	17	62	67	1.61	-.5	1.05	9	3	.0	0	12.5	se.				10	7	14	5.9	
Palestine	510	64	72	998.3			75	60	67.3	+.1	87	10	40	31	68			10.63	+7.3	3.55	9	2	.0	0	7.5	ne.	26	ne.	30	5	9	17	6.8	53
Port Arthur [4]	34	59	134	1,013.9	1,015.0	-1.6	78	67	72.6	+1.0	87	10	44	31	27	67	89	16.03	+12.7	8.18	16	3	.0	0	8.3	ne.	70	se.	4	5	9	17	7.2	38
San Antonio [2]	794	6	51	990.9	1,015.2	-1.1	81	60	70.6	+.1	91	20	41	31	40	58	69	7.58	+5.4	4.69	8	5	.0	0	10.7	ne.	42	n.	30	7	12	12	5.9	53
OHIO VALLEY AND TENNESSEE																																		
									61.6	+5.0							76	4.28	+1.6														5.9	
Chattanooga [2]	762	6	66	994.9	1,019.7	+.4	75	57	66.2	+8.5	86	8	39	1	69	58	81	9.91	+6.9	2.94	11	3	.0	0	3.4	s.	25	sw.	6	9	8	19	7.3	32
Knoxville [2]	995	27	71	985.1	1,020.0	+1.7	75	56	65.2	+6.6	87	10	40	1	83	57	79	6.67	+4.0	2.17	12	4	.0	0	5.2	ne.	26	s.	6	7	8	16	6.7	51
Memphis [1]	399	5	49	1,008.1	1,018.4	+.1	75	56	65.2	+3.8	88	8	35	31	111	57	78	8.16	+5.5	3.90	14	4	.0	0	6.8	n.	24	nw.	31	5	14	12	6.4	57
Nashville [2]	546	5	72	999.7	1,019.5	+.2	74	54	64.2	+3.2	88	7	38	1	121	56	80	4.38	+1.9	2.02	14	3	.0	0	5.6	s.	26	sse.	6	5	9	17	7.2	38
Lexington [2]	989	4	58	984.8	1,020.8	+2.2	71	52	61.4	+4.0	85	9	35	31	171	52	76	1.85	-.7	.80	12	1	.0	0	8.1	sse.				10	8	13	6.1	
Louisville [3]	525	5	54	1,001.7	1,019.8	+.8	73	52	62.2	+4.7	86	8	36	27	152	52	72	3.33	+.7	1.66	9	0	.0	0	5.9	ese.	28	s.	6	9	8	14	6.3	51
Evansville [2]	431	6	40	1,004.1	1,020.0	+1.0	71	51	61.0	+4.0	85	11	32	31	172	52	76	7.01	+4.2	1.61	12	4	.0	0	7.5	nnw.	31	nw.	31	7	12	12	6.0	54
Indianapolis [2]	823	5	54	990.2	1,020.0	+1.4	69	49	59.2	+5.1	84	8	30	27	221	49	74	4.25	+1.5	1.44	11	1	.0	0	8.7	se.	36	sw.	6	13	4	14	5.4	62
Terre Haute [2]	575	4	36	998.3	1,019.7	+1.4	70	49	59.1	+2.9	83	9	27	27	220	50	77	6.43	+3.7	2.32	10	4	.0	0	8.7	s.	31	s.	10	11	7	13	5.5	61
Cincinnati [4]	627	135	148	997.3	1,020.6	+1.3	72	53	62.6	+5.6	88	8	37	27	146	50	74	2.53	.0	.89	10	0	.0	0	8.1	ssw.	16	nw.	12	12	6	13	5.4	51
Columbus [4]	822	90	110	990.5	1,021.0	+2.0	70	51	60.9	+5.7	86	8	33	27	187	49	74	1.31	-1.2	.37	8	0	.0	0	7.1	se.	32	sw.	22	14	4	13	4.9	55
Dayton [2]	1,003	6	55	984.1	1,020.8	+2.5	68	50	58.6	+4.8	83	8	30	31	236	49	74	1.95	-.6	.70	9	0	.0	0	9.3	s.	32	w.	22	13	6	12	5.2	56
Elkins [2]	1,947	5	45	950.9	1,022.6	+1.9	70	44	56.8	+5.7	86	10	28	27	270	48	80	3.33	+.4	.93	13	0	.0	0	3.9	sse.	30	w.	22	8	8	15	6.3	54
Parkersburg	637	77	84				73	50	61.6	+5.5	89	10	29	27	172			1.28	-1.2	.62	12	0	.0	0	5.1		22	nw.	12	14	6	11	5.1	56
Pittsburgh [2]	842	39	54	975.3	1,021.4	+2.4	70	50	59.6	+5.5	88	10	34	27	213	47	66	1.79	-.7	.67	11	1	.0	0	8.2	s.	32	w.	22	14	5	12	5.3	52
LOWER LAKES																																		
									57.3	+5.8							73	2.27	-.6														5.0	
Buffalo [2]	768	34	96	992.6	1,021.1	+3.5	68	47	57.2	+6.1	85	10	32	31	273	45	69	1.67	-1.6	.49	9	1	.0	0	11.4	sw.	47	sw.	22	9	11	11	5.6	60
Canton	448	10	61	1,003.7	1,020.0	+3.4	64	42	53.2	+5.7	82	11	20	25	382			1.64	-1.4	.52	7	1	T	0	6.6		37	sw.	21	10	9	12	5.2	59
Oswego	335	71	85	1,008.1	1,020.7	+3.4	65	49	56.8	+6.5	85	11	32	25	281			1.55	-1.7	.62	8	0	T	0	8.4		27	nw.	26	10	10	11	5.4	58
Rochester [2]	523	4	69	1,001.7	1,021.2	+3.2	68	44	55.8	+4.3	89	10	29	25	315	46	75	.77	-1.9	.48	7	1	.0	0	6.5	sw.	45	w.	22	8	10	13	5.9	62
Syracuse [2]	596	5	57	998.6	1,021.4	+3.4	62	45	56.2	+6.7	86	11	31	25	297	47	74	1.36	-1.8	.37	11	0	.0	0	8.1	s.	40	nw.	26	7	12	12	5.9	49
Erie [4]	714	57	81				67	51	59.4	+6.0	88	10	34	27	219			1.31	-2.4	.65	10	0	.0	0	7.8		26	sw.	22	11	13	7	4.6	53
Cleveland [2]	762	27	54	992.6	1,020.7	+2.4	71	48	59.2	+6.5	87	8	26	27	229	48	71	1.04	-1.7	.50	8	0	.0	0	10.1	s.	37	w.	22	13	10	8	4.6	68
Sandusky	629	5	67	997.6			69	52	60.4	+6.1	88	9	31	27	199			1.24	-1.2	.52	7	0	.0	0	7.7		24	sw.	22	17	9	5	3.9	75
Toledo [2]	628	5	47	997.0	1,020.4	+2.2	68	48	58.0	+6.4	87	8	26	27	263	48	74	3.77	+1.4	2.06	7	1	.0	0	9.4	ssw.	36	nw.	22	15	5	11	4.8	73
Fort Wayne [2]	857	5	34	989.5	1,020.3	+2.0	68	46	57.1	+4.4	86	9	25	27	279	48	75	5.08	+2.5	2.47	8	0	.0	0	7.6	ssw.	35	s.	10	15	2	14	5.1	63
Detroit [2]	730	5	77	993.6	1,020.6	+2.6	67	48	57.4	+5.5	86	9	31	31	270	47	72	5.50	+3.1	3.55	8	0	.0	0	9.2	s.	43	nw.	22	14	9	8	4.4	70
UPPER LAKES																																		
									52.4	+4.5							74	2.24	-.4														5.5	
Alpena	609	5	89	995.9			61	42	51.8	+4.7	82	9	24	31	417			.75	-2.0	.24	9	1	T	0	10.6		34	sw.	10	11	10	10	5.5	57
Escanaba	612	51	72	994.6			58	43	50.2	+4.2	69	11	25	31	464			1.16	-1.5	.49	10	1	.0	0	10.5		41	s.	10	12	10	9	4.9	80
Grand Rapids [4]	707	70	244	993.6	1,019.3	+1.7	67	48	57.4	+6.2	85	8	31	31	266	45	74	1.73	-1.1	.94	10	0	T	0	10.8	s.	56	s.	10	10	10	11	5.3	67
Lansing [4]	878	5	90	987.5	1,020.2	+2.2	66	44	54.9	+4.6	84	8	25	31	335	45	72	2.35	-.1	.96	9	1	T	0	13.4	ssw.	41	s.	22	13	11	7	4.5	65
Marquette	734	44	73	988.5			60	42	51.2	+4.5	78	8	25	31	432			2.50	-.3	.66	14	2	4.6	2	9.4		47	s.	10	5	9	17	6.8	43
SaultSainteMarie [2]	614	10	52	990.5	1,017.8	+1.2	59	38	48.5	+5.6	76	8	20	31	507	42	82	3.12	.0	1.12	17	1	5.2	2	9.8	e.	43	w.	22	6	9	16	6.9	53
Chicago [2]	673	5	38	996.3	1,019.4	+1.4	67	47	57.2	+4.7	87	8	30	26	276	46	72	2.73	+.2	.82	7	2	.0	0	9.4	s.	45	s.	10	12	7	12	5.2	65
Green Bay	617	5	32	994.6	1,017.8	+1.2	63	40	51.6	+3.1	83	8	23	26	430	40	68	1.05	-1.5	.73	3	0	T	T	12.2	ssw.	66	sw.	10	11	13	7	4.9	66
Milwaukee [2]	681	33	66	992.9	1,018.6	+1.3	64	44	53.8	+4.3	83	10	27	31	357	45	75	1.62	-.7	.79	8	2	.0	0	12.5	sw.	60	s.	10	16	4	11	4.5	57
Duluth [4]	1,133	5	47	963.1	1,015.2	-.7	56	38	47.0	+2.9	73	3	18	31	558	37	76	5.38	+3.1	2.09	12	5	.7	0	18.9	wnw	57	sw.	10	5	13	13	6.6	41
NORTH DAKOTA																																		
									43.9	+.5							72	2.52	+1.4														7.0	
Fargo [2]	940	5	47	979.0	1,013.8	-2.1	57	35	45.9	+1.5	79	5	17	31	592	36	70	2.76	+1.1	1.26	9	2	T	0	16.0	s.	52	w.	10	5	10	16	6.7	43
Bismarck [2]	1,677	5	41	955.0	1,014.8	-2.1	56	33	44.4	+.8	90	5	19	26	646	35	73	2.06	+1.1	.87	13	4	.6	0	12.6	w.	47	nw.	29	6	9	16	6.7	50
Devils Lake	1,478	11	44	959.4			52	33	42.4	.0	85	5	20	26	701			3.94	+2.7	2.14	13	2	1.1	0	11.1		34	w.	29	9	6	16	6.4	50
Grand Forks [2]	832	4	41																															
Williston	1,878	42	50	946.5			53	33	43.0	-.4	77	15	22	20	682			1.33	+.5	.85	7	0	.6	0	9.0		37	w.	29	1	8	22	8.2	59
UPPER MISSISSIPPI																																		
									56.7	+3.9							72	2.87	+.4														5.2	
Minneapolis-St. Paul [2]	919	43	74	981.0	1,015.6	-.3	63	43	52.9	+4.0	80	8	20	31	376	40	66	1.72	-.4	.59	9	1	T	0	12.9	se.	65	s.	10	8	10	13	5.7	47
La Crosse [2]	672	5	29	992.2	1,017.0	+.4	65	41	53.2	+4.1	78	7	20	31	376	42	68	1.17	-1.2	.56	6	4	.0	0	9.6	s.	69	sw.	10	10	8	13	5.8	62
Madison [2]	974	27	39	986.1	1,018.4	+.8	66	42	53.6	+4.3	83	8	25	26	374	43	69	1.86	-.6	1.37	6	1	.0	0	12.4	s.	63	sw.	10	13	10	8	4.3	66
Charles City	1,015	10	51	980.7	1,017.6	+.3	66	42	54.0	+5.4	82	7	20	31	352			1.58	-.8	.68	8	3	.0	0	7.5		48	sw.	10	9	13	9	5.2	57
Moline [2]	606	6	50	996.3	1,018.8	+1.2	68	46	57.0	+5.0	87	8	25	31	289	45	69	2.27	-.1	1.54	7	3	.0	0	9.0		56	sw.	10	14	4	13	4.8	61
Des Moines [4]	860	5	99	986.1	1,017.6	+.7	69	46	57.1	+3.7	87	7	21	31	276	44	72	1.70	-.8	.66	10	4	.0	0	10.2	s.	54	s.	10	11	7	13	5.4	68
Dubuque	699	60	79	992.6	1,018.0	+.4	66	46	56.0	+4.1	86	8	26	31	304	46	73	1.87	-.6	.78	8	3	.0	0	5.5	s.	26	se.	10	10	10	11	5.1	65
Burlington [2]	702	4	36	992.9	1,018.8	+1.2	69	46	57.2	+3.4	87	8	21	31	284	47	78	1.89	-.8	.87	8	1	.0	0	11.1		47	sw.	10	14	7	10	4.9	66
Cairo	357	5	99	1,005.8			72	55	63.2	+2.7	84	11	35	31	135			6.55	+3.8	2.94	13	2	T	0	7.9	sse.	30	ne.	5	9	9	13	5.9	64
Peoria [2]	609	7	26	996.6	1,019.2	+.9	68	47	57.4	+3.9	85	9	26	31	266	47	72	2.71	+.4	1.35	10	3	.0	0	10.3	s.	47	sw.	10	13	4	14	5.2	59
Springfield, Ill. [4]	636	5	49	996.6	1,019.1	+1.1	68	48	57.9	+4.3	86	9	27	31	268	50	76	4.60	+2.1	1.64	10	3	.0	0	10.2	s.	44	s.	10	15	1	15	5.2	61
St. Louis [4]	568	33	59	998.3	1,018.8	+.8	69	53	61.2	+2.4	87	8	30	31	175	50	76	6.47	+3.8	1.73	11	5	.0	0	7.6	sse.	45	sw.	10	14	2	15	5.4	52

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR OCTOBER 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Date	Extremes: Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [4]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F		°F.			°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
MISSOURI VALLEY									56.0	+2.3							73	3.75	+1.6														5.1	
Columbia, Mo.[4]	784	6	66	989.5	1,018.2	+0.2	70	49	59.6	+2.7	88	7	25	31	227	49	78	5.31	+2.7	3.03	10	3	T	0	7.4	sse.	26	sw.	10	13	7	11	5.0	56
Kansas City[2]	963	38	76	990.2	1,017.6	.0	71	50	60.6	+2.9	88	7	26	31	195	48	69	5.70	+3.0	2.19	8	3	.0	0	8.0	ssw.	56	s.	10	12	7	12	5.2	64
St. Joseph[2]	967	5	51	982.1	1,017.2	−.1	71	47	58.9	+2.9	90	7	24	31	233	46	73	4.29	+1.4	2.91	6	5	T	0	10.1	sse.	36	sw.	10	12	10	9	4.9	61
Springfield, Mo.[2]	1,324	5	50	970.5	1,018.4	+.4	69	49	59.0	+1.4	84	8	26	31	232	49	78	8.46	+5.4	5.48	10	3	.0	0	8.7	sse.	40	sw.	10	13	5	13	5.1	57
Topeka[4]	987	65	87	985.4	1,017.5	+.2	71	49	60.2	+3.2	87	8	26	31	208	48	76	3.94	+1.5	1.93	8	3	.0	0	9.4	s.	30	sw.	10	12	8	11	5.2	58
Lincoln[4]	1,189	6	81	973.2	1,016.4	−.2	68	46	57.0	+2.8	87	7	22	31	268	44	73	2.99	+1.1	.97	9	7	.0	0	9.7	s.	44	s.	10	15	8	8	4.5	63
Norfolk, Nebr.[2]	1,551	5	38	960.0	1,016.0	......	66	40	53.0	+1.3	84	3	16	31	381	40	72	1.27	−.3	.66	7	2	.0	0	......	......	--	......	--	11	10	10	5.1	--
Omaha[2]	1,105	5	68	976.6	1,016.6	−.7	68	45	56.7	+3.3	88	8	20	31	280	43	68	3.22	+1.1	1.34	9	8	T	0	11.6	sse.	59	s.	10	13	8	10	4.8	60
Valentine	2,598	46	54	923.5	1,015.6	−1.7	60	37	48.3	−1.0	79	1	23	30	522	36	70	2.61	+1.5	1.49	7	5	T	0	9.6	......	40	n.	10	13	7	11	5.1	61
Sioux City[2]	1,138	5	40	974.6	1,016.1	−.8	66	41	53.8	+4.1	83	3	17	31	358	42	72	2.22	+.4	1.45	7	3	.0	0	10.5	sse.	70	w.	10	11	9	11	5.5	68
Huron[2]	1,301	5	41	967.5	1,015.0	−2.3	61	37	49.0	+1.3	81	5	17	31	503	38	72	1.21	−.1	.53	9	3	T	0	12.7	s.	72	w.	10	10	10	11	5.7	45
NORTHERN SLOPE									42.4	−2.8							65	1.39	+.3														6.8	
Billings[2]	3,570	16	39	891.3	1,017.1	−1.9	51	33	41.9	−6.1	76	15	19	21	717	29	65	2.72	......	1.08	11	1	23.1	0	12.7	sw.	68	nw.	10	6	7	18	7.1	29
Butte	5,533	44	58	830.3	1,020.8	......	48	22	35.4	−6.1	70	4	9	19	914	24	66	.62	−.2	.28	12	0	7.0	0	8.8	nw.	--	......	--	3	8	20	7.5	--
Glasgow	2,086	34	53	940.4	1,015.9	......	56	31	43.4	−1.2	78	15	16	21	667	30	61	.83	+.1	.43	8	1	1.8	0	......	......	--	......	--	1	9	21	7.9	--
Great Falls[2]	3,657	16	75	888.6	1,016.8	......	50	33	41.5	−5.7	71	4	15	18	731	28	63	.90	.0	.35	11	0	7.4	0	15.9	sw.	73	w.	28	5	5	21	7.7	48
Havre	2,507	11	67	926.5	1,016.6	.0	53	33	42.8	−1.7	74	15	19	21	688	....	..	1.41	+.7	.64	9	0	5.8	0	10.4	sw.	42	w.	5	0	12	19	7.7	42
Helena[2]	4,124	5	43	874.7	1,019.4	+1.4	51	28	39.6	−4.2	76	4	15	18	791	27	64	.28	−.3	.12	6	1	3.6	0	7.0	w.	47	sw.	28	3	7	21	7.6	52
Missoula[2]	3,263	4	32	903.8	1,020.1	+1.5	52	29	40.8	−2.5	68	4	19	17	755	30	69	.74	−.2	.33	6	1	.7	0	5.0	nw.	33	nw.	28	4	7	20	7.5	50
Kalispell	2,973	48	56	913.3	1,018.2	+.6	50	31	40.8	−2.7	61	1	20	19	751	30	..	.98	−.1	.40	9	1	.6	0	9.5	s.	--	......	--	5	3	23	8.0	--
Miles City[2]	2,371	5	28	931.3	1,016.6	−2.0	54	33	43.6	.....	80	15	19	21	658	31	..	2.43	......	.83	11	0	12.6	0	11.0	wnw.	--	......	--	5	10	16	6.9	--
Rapid City[2]	3,259	5	56	908.6	1,016.2	−1.8	59	36	47.2	−.4	93	5	21	21	554	32	66	.88	−.1	.60	6	0	.7	0	15.4	nnw.	63	nw.	10	8	9	14	6.2	55
Cheyenne[2]	6,094	22	40	811.0	1,016.0	−.6	56	32	43.6	−1.2	75	5	16	21	666	28	64	1.36	+.4	.52	7	2	7.2	0	12.5	w.	56	nw.	10	11	12	8	5.2	73
Lander[2]	5,352	6	30	829.0	1,017.6	−.4	51	28	39.6	−3.9	74	4	9	21	792	26	65	3.12	+1.8	1.14	10	1	27.8	0	6.1	......	44	sw.	5	12	9	10	4.7	64
Sheridan[2]	3,790	5	38	884.5	1,017.3	−.7	55	30	42.5	−2.1	82	15	18	21	696	28	65	1.99	+.9	.78	12	2	10.9	0	8.7	nw.	47	nw.	28	7	7	17	6.7	53
North Platte[2]	2,821	11	51	916.4	1,015.8	−1.5	64	39	51.4	+1.7	78	5	24	21	417	38	72	1.16	+.1	.96	6	4	T	0	11.5	ne.	34	se.	5	11	12	8	4.5	63
MIDDLE SLOPE									57.3	+.9							66	2.43	+.4														4.1	
Denver	5,292	106	113	836.4	1,015.2	−1.4	62	38	50.4	−.8	82	5	27	20	451	28	54	.85	−.2	.38	8	0	6.0	0	8.0	s.	43	nw.	10	10	14	7	4.8	67
Pueblo[2]	4,690	5	36	856.4	1,015.0	−.9	67	36	51.4	+.2	85	7	24	22	418	32	56	1.41	+.8	.53	7	1	2.3	0	5.8	w.	50	w.	10	15	9	7	4.1	71
Concordia	1,392	50	58	967.2	1,017.3	−.3	69	48	58.4	+2.5	91	7	26	31	242	43	63	3.14	+1.2	1.93	8	5	.0	0	9.3	......	31	s.	10	18	9	4	3.4	69
Dodge City[2]	2,509	5	58	927.9	1,015.4	−1.9	70	45	57.0	+.9	91	7	27	31	279	44	71	4.48	+3.2	4.14	6	2	T	0	13.5	s.	63	sw.	9	20	9	2	2.8	81
Wichita[2]	1,358	52	64	968.2	1,016.5	−.1	70	50	60.0	+1.4	88	7	26	31	218	48	70	1.91	−.9	.73	10	4	.0	0	14.6	s.	49	s.	9	17	6	8	4.2	71
Oklahoma City[4]	1,214	10	47	970.5	1,016.8	−.5	72	52	62.1	+.6	88	7	30	31	171	51	73	2.97	+.1	1.57	9	2	.0	0	13.0	s.	28	w.	10	15	5	11	4.4	63
Tulsa[2]	674	10	60	993.2	1,017.4	......	74	50	62.0	+.4	87	7	30	31	179	51	72	2.27	−1.1	.72	10	2	0	0	8.5	s.	34	s.	10	13	5	13	4.8	60
SOUTHERN SLOPE									62.7	−.7							64	2.34	+.3														3.9	
Abilene[2]	1,755	4	59	955.0	1,015.5	−1.1	76	53	64.6	+.3	94	7	35	31	137	50	65	4.00	+1.5	2.23	6	3	.0	0	12.1	s.	44	s.	21	14	8	9	4.6	67
Amarillo[2]	3,604	5	42	889.6	1,014.7	−1.9	71	44	57.8	+2.0	88	6	26	31	262	42	63	1.03	−.6	.67	5	2	T	0	10.9	s.	68	s.	1	19	6	6	3.1	73
Del Rio	960	63	71	981.4	1,014.2	−1.0	80	60	69.8	−.2	92	7	43	31	38	57	69	1.88	+.1	1.42	8	4	.0	0	7.3	se.	31	nw.	30	13	9	9	4.8	63
Roswell[2]	3,614	6	29	892.0	1,015.1	−.5	73	41	57.2	−2.3	89	7	26	31	262	38	54	1.10	−.3	.73	3	2	T	0	7.4	s.	43	s.	9	21	5	5	2.7	79
Wichita Falls[2]	1,030	4	49	979.7	1,016.2	......	75	53	64.2	−3.3	92	7	32	31	144	52	67	3.69	+.8	.54	7	1	.0	0	12.3	sse.	60	wnw.	10	15	6	10	4.5	--
SOUTHERN PLATEAU									62.4	−.9							45	1.19	+.5														2.8	
El Paso[2]	3,916	35	85	886.6	1,013.2	−.7	75	50	62.7	+.7	89	2	38	31	139	40	46	1.50	+.7	1.44	2	3	.0	0	8.9	n.	43	w.	9	19	8	4	2.9	77
Albuquerque[2]	5,314	5	45	849.0	1,013.4	−1.5	70	42	56.2	−.4	84	3	26	31	290	33	45	.14	−.7	.07	4	1	T	0	8.1	s.	57	s.	19	19	8	4	3.0	81
Flagstaff	6,907	34	48	791.4	......	......	60	31	45.2	−1.7	75	2	4	20	615	29	58	3.84	+2.4	2.01	6	2	6.9	0	6.2	nnw.	--	......	--	14	8	9	4.6	--
Phoenix[4]	1,107	39	87	973.6	1,011.8	−.1	84	56	70.0	−.6	98	2	39	21	49	44	46	.80	+.3	.74	3	3	T	0	4.3	se.	30	sw.	18	20	6	5	2.7	82
Tucson[2]	2,555	5	39	925.2	1,012.1	−.1	79	53	66.4	−2.3	92	1	35	21	78	39	41	.52	.0	.19	7	5	.0	0	7.2	sse.	37	e.	31	21	7	3	2.6	86
Yuma[2]	142	9	54	1,006.4	1,011.0	−.5	88	60	73.8	.....	102	1	44	20	25	41	34	.35	......	.28	3	3	.0	0	5.7	nne.	34	nw.	8	26	5	0	1.2	99
MIDDLE PLATEAU									47.0	−1.5							58	.99	+.2														4.3	
			41	809.7	......	......	58	28	43.0	+1.2	77	4	18	20	679	....	..	.61	−.2	.27	6	1	6.1	0	9.9	......	36	se.	17	16	5	10	4.4	66
Ely[2]	6,262	8	52	863.5	1,017.1	+.5	67	29	47.8	−.7	82	4	19	21	534	28	50	.11	−.2	.08	2	0	1.1	0	4.7	n.	34	nw.	6	19	5	7	3.3	81
Reno[2]	4,527	20	56	868.9	1,018.0	.0	62	27	44.6	−3.7	82	4	15	18	631	29	56	.72	+.1	.39	4	0	2.2	0	7.6	......	27	n.	19	15	7	9	4.3	74
Winnemucca[2]	4,339	5	46																															--
Modena	5,473	10	58	872.0	1,016.7	+.1	59	37	48.3	−2.5	84	4	28	22	520	36	67	2.79	+1.5	.75	10	1	1.1	0	8.4	sse.	42	nw.	17	13	6	12	5.2	60
Salt Lake City[2]	4,357	32	26	860.5	1,016.4	+.8	63	39	51.1	−1.7	80	4	27	22	433	34	57	.72	−.2	.48	5	1	T	0	8.0	e.	42	s.	8	16	8	7	4.2	68
Grand Junction[2]	4,602	5																																
NORTHERN PLATEAU									45.2	−3.6							64	.96	−.3														5.5	
Baker[4]	3,471	36	54	898.1	1,020.8	+1.5	56	30	42.8	−3.8	70	25	18	18	686	26	..	.17	−.7	.11	4	1	T	0	6.8	se.	24	n.	8	13	7	11	5.1	69
Meacham	4,056	7	28	879.4	1,021.0	......	50	32	40.6	.....	65	31	18	19	758	30	69	2.89	......	.69	9	0	4.2	0	5.9	ese.	--	......	--	8	11	12	6.2	--
Boise[2]	2,739	5	49	922.1	1,019.2	+.9	58	34	46.4	−3.7	70	4	24	19	576	31	59	1.20	.0	.55	7	0	T	0	11.6	nw.	38	w.	5	12	11	8	4.5	75
Burley[2]																																		--
Lewiston	1,436	4	23	967.2	1,019.8	......	58	35	46.8	.....	69	1	21	19	566	34	65	.35	......	.21	6	0	.0	0	5.8	e.	--	......	--	8	8	15	6.3	--
Pocatello[2]	4,478	5	31	864.2	1,019.0	+1.4	55	30	42.6	−3.9	79	4	17	22	697	29	64	1.17	−.5	.37	11	1	9.2	0	8.1	sw.	40	sw.	5	11	7	13	5.6	58
Ellensburg[2]	1,735	5	58	956.7	1,019.8	......	59	33	45.8	−2.4	70	24	17	19	598	33	66	.36	−.2	.32	4	0	.0	0	9.8	nw.	--	......	--	12	8	11	5.4	--
Lacrosse	1,544	5	43																															--
Spokane[2]	1,929	6	51	949.2	1,019.3	+1.3	55	33	44.2	−4.1	64	23	20	20	644	31	63	1.52	+.4	.79	7	1	.4	0	9.1	sw.	34	sw.	5	9	9	13	5.7	57
Walla Walla	991	57	65	983.4	1,020.7	+3.1	60	41	50.6	−2.9	70	24	26	19	443	36	..	.84	−.7	.35	7	0	.3	0	4.7	s.	25	sw.	5	9	10	12	5.7	58
Yakima[2]	1,076	4	54	980.7	1,018.5	+.9	64	30	47.3	−4.4	73	1	17	19	547	32	61	.13	−.5	.11	3	0	.0	0	7.4	w.	--	......	--	10	8	13	5.3	--

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR OCTOBER 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Date	Extremes: Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m. p.h.					0-3	4-7	8-10	0-10	%
NORTH PACIFIC COAST									49.0	−2.6							78	3.22	−0.1														6.4	
Kelso [2]	750	38	76				59	36	47.6		73	30	23	19	540	42	83	4.20		1.10	13	2	T	0	7.9	sse.				3	11	17	7.2	
North Head	211	5	55	1,012.9	1,020.7	+3.1	55	46	50.4	−2.5	70	30	39	18	451			5.52	+.5	1.58	15	1	T	0	11.8	n.	54	w.	4	6	10	15	6.7	48
Seattle [4]	125	90	321	1,016.3	1,020.7	+2.4	57	45	51.0	−2.7	65	14	33	19	433	44	83	3.45	+.6	1.29	14	2	T	0	7.6	s.	35	sw.	11	2	14	15	7.0	43
Tacoma	194	172	201	1,013.5	1,020.7	+2.7	56	43	49.6	−.9	68	31	32	20	477			2.86	−.5	1.39	12	0	T	0	7.0	n.	34	n.	18	6	11	14	6.5	46
Tatoosh Island	86	5	61	1,016.9	1,020.0	+3.1	54	45	49.4	−.5	62	31	40	19	482	44	87	7.07	−1.1	1.63	11	0	.0	0	11.9	ne.	57	s.	10	8	6	17	6.8	44
Burns	4,162	35	47	875.4	1,020.2		58	27	42.2	−3.8	70	15	13	18	708	24	54	.17	−.4	.09	4	0	T	0						16	6	9	4.3	
Eugene [2]	433	4	35	1,007.8	1,021.7		60	37	48.2		75	31	24	20	517	42	84	1.94		.60	10	0	T	0	6.3	s.				7	8	16	6.5	
Medford [2]	1,329	29	58	972.9	1,021.4	+3.8	64	36	50.0	−3.6	82	1	20	19	465	38	72	1.89	+.5	.88	7	0	T	0	5.6	n.				13	8	10	4.7	
Portland, Oreg. [4]	154	68	106	1,015.6	1,021.5	+3.5	59	43	51.0	−3.2	69	31	33	20	432	43	84	2.72	−.4	1.28	11	1	T	0	4.4	nw.	26	s.	9	2	13	16	7.4	34
Roseburg	510	45	76	1,003.1	1,021.9	+3.6	60	41	50.6	−3.3	74	31	27	19	443			2.42	−.2	.95	9	0	T	0	3.4	nw.	20	n.	12	3	13	15	7.1	37
MIDDLE PACIFIC COAST									59.0	−1.3							51	.56	−.8														2.7	
Auburn [2]	1,651	4	58																															
Eureka	60	72	88	1,017.6			57	44	50.7	−2.9	73	30	34	19	439			2.03	−.3	1.53	5	0	.0	0	6.0		32	n.	12	13	10	8	4.5	67
Red Bluff [2]	353	5	26	1,003.1	1,015.2		79	50	64.3	.0	95	3	39	21	112	30	30	T	−1.3	T	0	0	.0	0	8.6	nw.	26	nw.	12	24	2	5	2.3	93
Sacramento [4]	66	92	115	1,013.2	1,015.0	−.2	76	49	62.6	−.3	90	3	37	20	132	40	50	.14	−.8	.14	1	0	.0	0	9.6	nnw.	25	nw.	8	26	4	1	1.2	94
San Francisco [4]	155	112	132	1,015.9	1,016.2	+.3	66	51	58.5	−2.0	84	30	45	20	218	46	73	.08	−1.0	.06	3	0	T	0	12.7	nw.	27	w.	5	18	8	5	2.9	95
SOUTH PACIFIC COAST									64.4	+.5							58	.08	−.5														2.5	
Fresno [2]	327	5	34	1,003.1	1,014.5	−.7	80	45	62.6	+.3	94	4	30	19	142	39	46	T	−.6	T	0	0	.0	0	5.9	nw.	29	w.	18	26	5	0	1.2	97
Los Angeles [4]	338	236	263	1,010.8	1,014.2	−.4	76	56	66.2	+.9	90	12	47	21	54	48	65	.01	−.7	.01	1	0	.0	0	6.4	w.	24	w.	18	21	5	5	3.1	77
San Diego [2]	87	20	55	1,011.5	1,014.2	.0	73	56	64.3	+.2	86	30	45	21	60	49	62	.23	−3	.23	1	0	.0	0	6.5	ssw.	26	w.	18	17	7	7	3.1	71
WEST INDIES																																		
San Juan, P. R.	82	9	54	1,010.2	1,012.9		84	75	79.6	−.2	90	10	72	22	0			4.21	−1.6	.89	18	9	0	0	7.7	s.	31	e.	28	1	14	16	7.3	44
ALASKA																																		
Anchorage [2]	132	6	44	1,000.0	1,005.1		42	28	35.2	−.8	52	19	14	23	925	28	72	1.25	−.9	.40	8	0	7.3	2		n.	43	s.	19	4	8	19	7.5	
Annette Island	113	5	53	1,008.5	1,012.5		50	42	46.3	−.7	55	2	31	17	583	43	88	20.38	+4.3	2.55	27	0	T	0	14.2	ese.				1	3	27	9.3	
Barrow	29	5	27																															
Bethel [2]	28	5	31	1,002.4	1,004.1		39	28	33.6	+2.1	47	27	17	24	976	31	88	2.79	+1.0	1.28	12	0	T	T		n.	25	ese.	16	2	6	23	8.3	
Cordova [2]	45	5	32	1,001.7	1,003.7		48	31	39.9	−.6	56	5	20	16	777	35	80	13.51	.0	3.13	20	0	.1	0		e.	35	e.	12	7	4	20	7.2	
Fairbanks [2]	455	5	63	989.5	1,007.1		36	20	28.0	+1.4	47	1	4	16	1,157	26	86	.43	−.4	.15	10	0	5.7	2		nw.	26	s.	15	3	2	26	8.4	
Galena	139	4	66																															
Gambell	32	5	32	1,003.1	1,004.1		37	32	34.5	+3.3	40	1	22	31	944	32	88	1.54	+.2	.30	17	0	7.2	T		n.	50	ne.	12	0	1	30	9.6	
Juneau [2]	80	6	30	1,008.6	1,009.5		47	36	41.6	+.3	55	30	22	17	729	38	85	8.50	+.2	1.74	25	0	2.1	0		ese.	50	se.	29	2	4	25	8.5	
Kotzebue [2]	20	5	31																															
McGrath [2]	341	5	31	993.9	1,006.8		35	22	28.4	+.9	45	1	8	14	1,139	24	78	1.30	−.6	.37	13	0	8.1	6	5.0	wnw.				6	4	21	7.5	
Nome [2]	22	10	75																															
Northway [2]	1,718	5	32	944.8	1,009.1		28	14	21.0	−4.0	49	1	−5	29	1,364	18	80	.79	+.2	.25	8	0	10.5	7		nw.				0	5	26	9.0	
St. Paul Is	28	4	39	1,000.7	1,001.7		42	34	38.0	−1.0	47	8	28	4	836	35	86	4.44	+1.1	1.93	20	0	.8	0						0	6	25	8.8	
Yakutat	31	5	50	1,005.4	1,006.8		48	34	41.2	−.9	58	6	22	16	743	37	84	18.97	−.8	1.91	24	1	3.4	0		ese.				5	0	26	8.2	
HAWAII																																		
Honolulu [4]	38	86	98	1,116.3	1,016.6		81	72	76.4	−.4	83	3	68	29	0			.45	−1.1	.19	12	0	0	0	11.1		25	e.	9	9	18	4	4.9	67

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations, according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport, remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE STORMS FOR OCTOBER 1949

[The table hereunder contains such data as have been received concerning severe storms that occurred during the month.]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Woodville (4 miles south of), Tyler County, Tex.	3	2:20 p. m.	100	0		Tornado	Timber leveled and power lines broken.
Texas	3-4	Night			$400,000	Tropical disturbance.	Developed in Gulf of Campeche on 1st, moved northward across Gulf of Mexico, passing inland during night of 3d and 4th with center a short distance west of Freeport at midnight of 3d. Winds reached whole gale force, with gusts of hurricane force in Galveston-Galveston Bay area and tides generally from 4 to 6 feet above normal. Highest tides from Kemah-Seabrook area northward to head of Galveston Bay and in Houston Ship Channel. Lowest barometer at Weather Bureau office in Galveston 29.43 inches at 3:50 a. m., 4th. Fastest mile of wind, 66 m. p. h. from southeast at 11:18 p. m., 3d. Damage in Galveston confined to water fronts, where county fishing pier completely destroyed. Some warehouses on wharves flooded and a few poorly constructed buildings located where no protection by seawall, damaged by wind and washed from foundations. Practically all wooden piers and some water-front buildings greatly damaged or completely destroyed from Texas City to La Porte, as result of winds and high tides. Some roofs damaged and a few minor structural damages in Galveston proper. About 550 telephones in Galveston and Texas City out of order. Coastal highway between Port Bolivar and Port Arthur, also Houston highway between mainland end of Causeway and La Marque impassible.
Lancaster County (northeastern portion), Nebr.	4	2-2:15 a. m.	[1] 1½			Hail	Storm path 9 miles long. Hailstones ¾ to 1 inch in diameter. Some loss of seed crops and slight damage to wheat.
Louisiana, western parishes	4-5					Wind and rain	Part of hurricane which moved inland on upper Texas coast on 4th. Heavy rains and high winds damaged mature rice in southwest and open cotton in northwest. Greatest damage to cotton was loss of quality and damage to seed, both for planting and processing for oil. Seed obtained afterward of no use for planting and quality for oil is cut about 50 percent. Late cotton undamaged and not more than 20 percent of early crop damaged.
Eddy, Foster, and Barnes Counties, N. Dak.	5	Afternoon			15,000	Wind	Winds up to 60 m. p. h. blew down trees and damaged farm buildings.
Houston, Tex	7	8:40 a. m.	17	0	6,000	Tornado	Storm occurred 3 miles southeast and 5 miles north-northeast of center of Houston. Funnel cloud observed from window of Weather Bureau office. Auto overturned, plate glass broken in cafe, and 2 houses and 1 garage damaged.
Atlanta, Ga	7	Mid-afternoon			500	Thunderstorm	Rainfall of 2.54 inches, mostly in 30 minutes. Accumulation of water so great that a low-lying section was flooded to extent that automobiles were almost submerged. Water entered a number of stores, damaging stock and causing moderate damage to yards of several homes.
Reno County, Kans	9	1:30 p. m.	440	0		Tornado	Path extended from 1 mile west to 5 miles north of Hutchinson. Funnel cloud observed. Little damage.
Pawnee and Rush Counties, Kans.	9	3:30-4 p. m.	[1] 2	0		Tornado and wind	Path of tornado began 3½ miles north of Rozel and extended northward to a few miles south of Rush Center. Farm buildings and some crops destroyed, intermittently, along path.
Rush County, Kans	9	4:30 p. m.		0	108,000	do	Damage from 12 miles south of Rush Center to 4 miles east and 5 north of La Crosse. Washing of fields damaged considerable wheat. 2 persons injured as result of auto accidents during storm.
Osborne County, Kans	9	5 p. m.	100	0	35,000	Tornadic	Damage in various parts of county. Some homes and business houses damaged in Osborne.
Stafford County, Kans	9	Afternoon				Wind	Most damage at Stafford Airport, where hangars blown over and several planes wrecked. Large plate glass windows blown in along business section.
McPherson County, Kans	9	do		0		Tornadoes and wind	2 small tornadoes; 1 cloud observed west of McPherson and the other near Mound Ridge, in southeastern portion of county. Windmills and 2 oil derricks blown down and barns and greenhouses unroofed. Some sheep injured. Both storms of short duration.
Kansas City, Mo	9	6:05 p. m.	35-70	0	5,000	Tornado and rain	Storm moved northwestward. In contact with ground for a distance of about 4 city blocks. Most damage to 1 residence and to roofs of a few dwellings. Minor damage to power lines and communications lines.
Beaver and Harper Counties, Okla.	9	7-10 p. m.	200-880	0	86,000	Tornado	Twister struck community of Slapout in Beaver County, skipped to Rosston in Harper County, and then to Girard and Willard communities in northern Harper County. Path northeastward for about 35 miles. 2 persons injured. Majority of damage to farm buildings. About $5,000 damage to grain sorghums. 11 homes in Harper County damaged. Church at Girard destroyed, and 2 trailer homes nearby demolished.
Cloud County, Kans	9	7:15 p. m.	100	0		Tornadic	Most damage in southern part of county. Some damage from straight wind, but in southwestern portion there was evidence, by the shrill whistle, of a tornado. A number of farm plants destroyed.
Borger, Hutchinson County, Tex.	9	7:45 p. m.			25,000	Wind	Garage destroyed, windows broken, and small house flattened.
Barton County, Kans	9	8 p. m.			9,000	do	Squall moved northeastward. Damage mostly to roofs and crops near Great Bend.
Lincoln (northern edge of), Nebr.	9	9:45 p. m.	50-150	1	40,250	Tornado	In path 2 miles long, twister almost completely destroyed 2 houses and damaged roof and upper portion of another. Much damage to farm buildings and contents. Crop losses and loss of livestock amounted to $2,500, included in total. 4 persons injured.
Pawnee County, Kans	9	10 p. m.			20,000	Wind and hail	Damage in various parts of county. Windows blown in, houses unroofed, and some old buildings blown over. Power and telephone lines broken.
Rush County, Kans	9	11 p. m.		0		Tornado and wind	Storm struck northeast of Bison, damaging a number of farm buildings. No defined path. Minor damage at several farms southeast of Bison about the same time.
Mitchell County, Kans	9	11 p. m.			250,000	Wind	Homes and business buildings partially damaged at Beloit. Several buildings at Girls School blown down. 8 persons injured. A number of farm homes, barns, and granaries over county destroyed.
Hobart and vicinity, Kiowa County, Okla.	9	11-11:34 p. m.			10,000	do	Damage to roofs, fences, trees, signs, and plate glass windows.
Nuckolls County (extreme eastern portion) and Thayer County (extreme northwestern portion), Nebr.	9	11 p. m.-midnight.	[1] 1-2	0	55,000	Tornado	Path 25 miles long. Losses of $4,000 to crops and $1,000 to livestock, included in total.

[1] Miles instead of yards.

SEVERE STORMS FOR OCTOBER 1949—Continued

[The table hereunder contains such data as have been received concerning severe storms that occurred during the month.]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Russell County, Kans	9	11:15 p. m	1,320	1	150,000	Tornado	Numerous indications of a tornado but, due to darkness, no funnel cloud observed. Path extended northeastward across town of Russell. Business houses along Main Street bore brunt of damage. Many plate glass windows blown in, trailer houses turned over, power and telephone services cut off, and a number of buildings blown down. Damage extended over a considerable portion of county.
Reno County, Kans	9	11:30 p. m	440	0	50,000	Tornado and wind	Tornado moved from near Lerado northwestward 25 miles to about 5 miles west of Hutchinson. Some crops destroyed, but principal damage to buildings. Power and telephone lines blown down.
Jewell County, Kans	9	Evening				Wind	Various parts of county reported damage, but most destruction in southeast, where quite a number of farm houses received more or less damage.
Geary County, Kans	9	Midnight				do	Trees and power lines downed. Plate glass windows in a few stores blown in at Junction City.
Beckham and Washita Counties, Okla.	9-10	10:45 p. m.-1 a. m.	440	0	20,000	Tornado	Tornado did several thousand dollars damage to Traders Compress Bldg., in Elk City; skipped to Canute vicinity, where several farms and outbuildings damaged; then moved to Foss in Washita County, where about $1,000 damage occurred. Path east-northeastward for about 16 miles.
Nebraska	9-10	Night of 9th-10th to evening of 10th.			1,000,000	Wind	Northward moving intense depression caused at least slight damage in most counties in eastern part of State and some in west. Winds highest in northeast, with gusts up to 75 m. p. h. at Norfolk. Much corn blown from stalks and numerous buildings damaged. About $10,000 damage to power and telephone lines included in total. Damage from tornadoes and tornadic winds listed on 9th for this State not included in this general storm damage.
Omaha and vicinity, including Papillion, Nebr.	9-10			1		do	Man killed when he contacted door of car against which power line had blown. Walls blown down. Power lines damaged considerably.
Colorado (east of Continental Divide).	10	Midnight of 9th-5 a. m., 10th.	[1] 200	2	500,000	Wind, rain, and snow.	Wind became strongest shortly after midnight, reaching maximum speed of 80 m. p. h. in some localities and averages of 40 to 50 m. p. h. in most areas. A 300,000-pound coal-conveying crane at Valmont power plant near Boulder, valued at $200,000, was a total loss. Severe losses also resulted from toppled trees, broken telehpone and power lines, and smashed windows. Two lives lost when speeding car rammed wind-felled tree at Saguache.
Marion and Chase Counties, Kans.	10	1 a. m	[1] 1		12,000	Wind	Storm damage from southwest of Florence northeastward to 4 miles north of Cedar Point. Some evidence of tornado formation. Plate glass windows broken in Florence. Trees broken and buildings blown over or unroofed.
Hartington (west and northwest of), Nebr.	10	2 a. m	440	0	150,000	Tornado	Path 8 miles long. Several farm buildings destroyed or damaged, and several houses slightly damaged. Damage from corn blown down, $75,000.
Wisconsin	10	9 a. m. to sunset		6	1,000,000	Wind	Southwesterly gales most severe in northwestern portion, although all sections sustained some property damage. Wind speed reached 69 m. p. h. at La Crosse, 65 m. p. h. at Land O'Lakes, and 57 m. p. h. at Duluth, with gusts up to 76 m. p. h. at latter place. Telephone and electric power services disrupted due to broken poles and trees falling across wires. Much minor damage to buildings, such as broken doors and windows, and damaged roofs and chimneys. More than 30 large barns demolished or severely damaged. Much standing corn flattened, resulting in increased harvest costs. Many apples blown from trees. Several persons injured by broken glass, tree limbs, and other objects.
Minnesota, southern, central and northeastern counties.	10	A. m. and p. m		4	2,500,000	do	Strong wind with occasional gusts up to 100 m. p. h. Loss to property extensive, but locally mostly minor. Hundreds of trees uprooted; many poles, wires, radio and high tension towers down; many small boats capsized and docks damaged; Lake Superior traffic impeded; a number of airplanes on ground and in hangars wrecked; at least 50 barns and many outbuildings, garages, silos, windmills, and steel Quonset-type corn cribs demolished; damage to roofs, chimneys, windows and signs particularly severe; many barns moved from their foundations; an 85-foot high brick chimney toppled; grain elevators, lumber sheds, drive-in theaters partially or totally destroyed; neon signs, billboards and scaffolding downed; falling trees blocked traffic, disrupted communication and power services and wrecked or damaged automobiles; some livestock and poultry perished or injured. More than 81 persons injured. Much corn in shock blown down; damage considerable.
Iowa	10	Entire day				do	Winds of gale and hurricane force made this one of the windiest days on record. Winds swept entire State, but extreme winds concentrated in northern portion. At Mason City airport, peak gust of 90 m. p. h. registered at 12:13 p. m. Also, from 10 a. m. until 2:30 p. m. velocities regularly averaged above 60 m. p. h. Much of the year's corn crop flattened, trees and large limbs blown down disrupting telephone and power services; roofs of buildings ripped off, plate glass windows blown out. Heaviest damage, undoubtedly, to corn crop where early estimates indicated 5 to 7½ bushels of dropped ears per acre on ground. Individual fields varied considerably from this State-wide average. Many sections experienced difficulties with mechanical pickers, making it necessary to either pick corn by hand or turn hogs into fields. At Decorah, high winds dismantled a high television aerial. At Mason City, radio stations off the air part of the day, due to power failure; many telephone lines down; several large store windows blown out. In Des Moines, about 400 wire breaks; gusts registered up to 62 m. p. h.; considerable minor damages. At Fort Dodge, a plane damaged; a drive-in theatre suffered an estimated $5,000 damage; 15 grain bins under construction destroyed or damaged. At Waterloo, 9 men injured when wind blew down a big sign display at Dairy Cattle Congress; loss estimated near $100,000. Throughout most of Iowa, reports similar to the above. Claims received by wind insurance companies among greatest in their history. Shingles torn from roofs one of the most frequent claims. Over 10 percent of farms in State suffered significant property losses. Overall loss, both property and agricultural, expected to run into millions of dollars.

[1] Miles instead of yards.

SEVERE STORMS FOR OCTOBER 1949—Continued

[The table hereunder contains such data as have been received concerning severe storms that occurred during the month.]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Illinois, northern and central portions.	10	All day				wind	Much corn blown down, especially where weakened previously by borers. Property damage small, mainly broken wires and minor roof damage.
South Dakota, eastern portion.	10	Forenoon	[1] 80	2	$500,000	do	Winds in area east of trajectory of an intense low, Gregory County to Grant County, caused damage to corn crop, buildings, and airplanes. Northerly winds to west of low pressure did less damage. Corn stalks in southeast corner of State downed easily, having been previously damaged by corn borer. Corn crop greatest loss, since windstorm came at corn-picking time. Gusts reached 60 to 70 m.p.h. Strong winds of 50 m.p.h. or more continued for 60 minutes during passage of center of storm. Station barometer readings dropped to record lows of 27.377 inches at Huron and 27.325 inches at Sioux Falls.
Barnes, Ramsey, and Richland Counties, N. Dak.	10	Afternoon			35,000	do	Winds reaching 65 m.p.h., damaged standing corn, and farm buildings. Buildings at Wahpeton damaged.
Western Upper Michigan	10	do		1		do	Hurricane force winds isolated communities by interrupting power and telephone services up to 3 days. Barns, houses, airplanes, and trees blown over; windows and signs broken. Small vessels damaged in Lake Superior and Lake Michigan. Probably highest sustained winds ever observed in this area. One death occurred at Marquette when electrician touched truck charged by broken wire.
Western Lower Michigan	10	do				do	Gale winds caused minor damage to timber and old buildings. In fruit area, late apples still on trees lost.
Billings, Mont.	10					do	Slight damage to trees and shrubs. Store window blown in.
Taylor County, Fla	11					Hail	Heavy hail with marble size stones fell in southern portion of county.
Lagrange, Ga	17	3-3:10 p.m.				Electrical and hail	Local thunderstorm, accompanied by lightning and hail, caused mostly light damage. Electric service interrupted. Lightning stunned 1 person, who received first-degree burns.
Great Falls (20 miles north of), Mont.	17–18			1		Blizzard	Man found dead in car which stalled in snowbank.
Shelby, Mont.	17–18			1		do	Boy lost in storm, frozen to death.
Idaho, south-central and southeastern portions.	17–19					Snow and electrical	During 3-day period snowfall nearly continuous, much of it melting as it fell, or soon afterward, but with enough accumulation, particularly at higher elevations, to produce a definite hazard to highway traffic and greatly delay harvesting of potatoes and sugarbeets. On 18th lightning struck farm home near Idaho Falls, injuring 6 persons by shock, flying glass, and burns.
Oklahoma City, Okla	18	4 p.m.				Electrical	Lightning struck house under construction, causing minor damage. 5 carpenters knocked down by the bolt, but only 1 injured.
Jackson County, Kans	20	3 p. m.	880	0	10,000	Tornado and rain	Path of damage extended from 2 miles southwest of Hoyt to 3 miles northeast of town. No funnel cloud observed, due to heavy rains. Houses, barns, and outbuildings destroyed, and power and communications lines cut. A large truck toppled from highway.
Abilene (1 mile north of), Tex.	21	12:15 a. m.	15	1	4,000	Tornado	Residence demolished, killing 1 person and injuring 3 others. Storm apparently dipped to earth for only an instant.
Jacksonville, Ill	21	3 a. m.				Wind	A partially completed church building badly damaged. Several trees uprooted, breaking utility lines.
Great Falls, Mont	28	Afternoon				do	Extremely high winds began about 3:10 p. m. and lasted until 3:26 p. m., with gusts reaching 86 m. p. h. at about 3:20 p. m. 2 planes that broke loose were damaged, 1 loosing its fuselage, also 1 damaged a third that was tied down.
Flathead Valley, Mont	28					do	In west and lower valley sections 25 to 30 telephone and electric power poles blown down. Telephone and teletype services out from 2:15 to 5 p. m.
New Market, Del	31	6:15 a. m.		0	16,500	Tornado	2 dwellings wrecked beyond repair, 5 more damaged extensively, and several barns and chicken houses flattened by freak twister. Although no one was hurt seriously, 1 man was taken to a hospital and X-rayed. A horse and mule injured when barn collapsed. Trees blown through upper story windows of home, causing considerable damage. 3 tractors damaged.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR OCTOBER 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the Monthly Weather Review, vol. 72, No. 1, January 1944, p. 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in vol. 75, No. 3, March 1947, p. 47.

Beginning with this issue, daily totals and weekly means of total solar and sky radiation received on a horizontal surface at Caribou, Maine, will appear regularly in table 2. The coordinates of the station are latitude 46°52′ N., longitude 68°01′ W., and the elevation is 7 meters. The horizon here is unusually free of obstructions and there will be no shading of the instrument at any time of the year. The station is equipped with an Eppley 180° pyrheliometer and Brown strip-chart potentiometer.

The record for Portland, Maine, is being resumed beginning with this issue, and will appear regularly in table 2. Publication of this record has been omitted since March 1949, pending an inspection of the station. Information concerning this station relative to coordinates, instrumental equipment, and observation to the free horizon is contained in the March 1949 issue of this publication.

In accordance with instructions regarding publication of solar radiation data at newly established stations, both of these stations have been officially inspected and approved.

At Ithaca, N. Y., use of a new planimeter has corrected evaluation of data. Publication of that record is being resumed with this issue.

Solar radiation equipment at Columbia, Mo., was transferred on October 21, 1949, from the University of Missouri to the Weather Bureau office. It was then discovered that the pyrheliometer bulb was defective because of the presence of innumerable water droplets on the inside of the bulb. Consequently, for an indeterminate period prior to October 1949, the published data for this station may be in error. Recordings and publication of data will be resumed as soon as installation of a replacement can be completed.

TABLE 1.—*Solar radiation intensities during October 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance: A. M. 78.7°	A. M. 75.7°	A. M. 70.7°	A. M. 60.0°	0.0°	P. M. 60.0°	P. M. 70.7°	P. M. 75.7°	P. M. 78.7°	Vapor pressure 7:30 a. m.[1]	Vapor pressure 1:30 p. m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
October										*mb.*	*mb.*
1	0.68	0.76	0.95	1.15	------	------	------	------	------	6.9	6.9
5	.68	.79	.94	1.07	------	------	------	------	------	8.7	10.2
11	.71	.92	1.02	1.15	------	------	------	------	------	10.6	9.8
12	.94	1.03	1.13	1.25	------	1.22	------	------	------	6.4	7.2
13	.79	.87	.99	1.16	------	1.15	0.90	------	------	7.4	9.4
15	.80	.90	------	1.16	------	------	------	------	------	5.3	6.6
17	.47	.53	.71	.88	------	1.02	------	------	------	7.2	10.2
18	.33	.45	.52	.80	------	------	------	------	------	7.2	15.3
22	.88	.98	1.11	1.28	------	------	------	------	------	4.8	6.4
24	.96	1.04	1.16	1.35	------	1.31	------	------	------	4.4	4.4
26	.91	1.03	1.15	1.31	------	1.33	------	------	------	4.0	4.4
28	------	.68	.80	.95	------	------	------	------	------	5.6	8.7
29	.69	.79	.96	1.18	------	------	------	------	------	8.7	8.4
31	.95	1.06	1.16	1.33	------	1.34	------	------	------	3.5	3.5
Means	.75	.84	.97	1.14	------	1.23	.90	------	------	------	------
Departures	+.02	-.03	-.04	-.04	------	+.02	-.12	------	------	------	------

TABLE 1.—*Solar radiation intensities during October 1949*—Con.

Date	Sun's zenith distance: A. M. 78.7°	A. M. 75.7°	A. M. 70.7°	A. M. 60.0°	0.0°	P. M. 60.0°	P. M. 70.7°	P. M. 75.7°	P. M. 78.7°	Vapor pressure 7:30 a. m.[1]	Vapor pressure 1:30 p. m.[1]
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
October										*mb.*	*mb.*
11	------	------	------	------	1.32	1.24	1.09	0.99	0.90	8.4	8.4
12	0.81	0.92	1.05	1.20	1.29	1.21	1.08	.94	.84	7.8	8.1
13	.68	.77	.92	1.09	1.19	1.12	.94	.77	.67	8.7	10.6
17	------	------	------	------	1.14	1.01	.86	.71	.62	9.4	11.4
24	------	------	------	------	1.26	1.14	.96	.83	.72	5.1	5.6
27	------	------	------	------	------	------	.92	.84	.73	8.1	11.4
31	.81	.92	1.05	1.22	1.31	1.20	1.03	------	------	3.0	4.8
Means	.77	.87	1.01	1.17	1.25	1.15	.98	.85	.75	------	------
Departures	-.02	-.04	-.05	-.08	-.19	-.08	-.07	-.07	-.06	------	------
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
October										*mb.*	*mb.*
2	------	------	------	1.47	------	------	------	------	------	------	------
4	1.10	1.19	1.30	1.43	------	------	------	------	------	------	------
6	------	------	------	1.48	------	------	------	------	------	------	------
11	------	------	------	1.43	------	------	------	------	------	------	------
12	1.12	1.20	1.31	1.43	------	------	------	------	------	------	------
23	------	------	------	1.49	------	------	------	------	------	------	------
26	1.21	1.29	1.39	1.51	------	------	------	------	------	------	------
27	------	------	------	1.47	------	------	------	------	------	------	------
28	------	------	------	1.46	------	------	------	------	------	------	------
29	------	------	------	1.47	------	------	------	------	------	------	------
31	------	------	------	1.49	------	------	------	------	------	------	------
Means	1.14	1.23	1.33	1.47	------	------	------	------	------	------	------
Departures	-.01	-.01	-.01	+.01	------	------	------	------	------	------	------
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
October										*mb.*	*mb.*
13	------	------	------	------	------	1.27	1.11	0.92	0.90	9.4	9.8
14	------	------	------	------	------	1.32	1.20	1.14	1.05	10.2	10.6
27	------	------	------	1.17	------	1.34	1.18	1.17	1.06	5.1	4.4
28	------	0.56	0.65	1.22	------	1.29	------	------	------	6.8	7.2
Means	------	.56	.65	1.20	------	1.30	1.16	1.08	1.00	------	------
Departures	------	-.21	-.22	+.16	------	+.17	+.25	+.32	+.33	------	------
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
October										*mb.*	*mb.*
1	0.93	1.02	1.14	1.34	------	1.36	1.20	1.09	1.01	9.9	5.7
2	.93	1.03	1.15	------	------	1.33	1.18	1.05	.93	7.0	7.8
3	.90	1.00	1.12	1.29	------	1.25	1.11	.97	.88	8.9	8.8
5	------	------	------	------	------	------	------	.89	.76	15.6	16.8
6	.99	1.09	1.20	------	------	------	------	------	------	8.3	7.5
10	------	------	------	.97	------	1.02	.72	.58	.52	20.0	20.0
11	------	------	------	------	------	.97	.89	.78	.70	18.3	21.7
12	------	------	------	------	------	1.25	1.10	.99	.85	19.7	14.6
13	------	.95	1.11	1.31	------	1.23	1.01	.86	.80	8.5	8.4
14	------	.90	1.10	1.33	------	1.32	1.18	1.06	.95	11.8	8.6
16	.84	.99	1.13	1.34	------	1.37	1.25	1.12	1.05	8.9	7.3
20	------	------	------	------	------	------	------	------	.78	6.8	7.9
21	.91	.99	1.14	1.27	------	1.15	.85	.66	.55	8.3	7.7
23	.92	1.01	1.14	1.27	------	1.29	1.10	.97	.85	7.1	6.8
27	1.03	1.12	1.24	1.40	------	1.39	1.25	1.14	1.00	4.3	4.0
Means	.93	1.01	1.15	1.28	------	1.24	1.07	.94	.83	------	------
Departures	+.07	+.06	+.07	+.05	------	+.04	+.05	+.04	+.05	------	------
RATIO, BOSTON-BLUE HILL ON COMPARABLE DATES											
	------	------	------	0.84	------	1.00	1.01	1.06	1.09	------	------

*Extrapolated.

[1] 75th Meridian Time.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct + diffuse) received on a horizontal surface during October 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Soda Springs, Calif.	Seabrook, N. J.	Grand Lake, Colo.	Salt Lake City, Utah	New York, N. Y.
1949													
Oct. 1	604	552	375	392	527	475	482	446	(533)	443	290	392	452
Oct. 2	620	582	404	313	462	456	476	348	(511)	400	430	435	438
Oct. 3	587	433	312	327	256	450	454	407	(512)	366	395	404	229
Oct. 4	525	390	120	404	136	473	425	388	(470)	370	493	406	228
Oct. 5	625	534	298	304	170	484	458	289	(439)	229	474	229	177
Oct. 6	490	460	250	230	420	489	440	207	(353)	133	329	299	339
Oct. 7	480	408	268	260	410	498	484	134	(307)	84	491	46	163
Means	562	480	290	319	340	475	460	317	446	289	414	316	290
Departures	−17	−20	−82	−68	00	+45	+56	−7	+2	-----	+16	+13	−10
Oct. 8	554	501	410	316	264	481	465	348	(516)	325	342	111	201
Oct. 9	588	449	406	443	270	469	418	392	(428)	375	300	268	-----
Oct. 10	652	464	396	427	429	438	266	398	(355)	373	141	89	301
Oct. 11	621	573	401	414	368	440	433	413	(455)	405	367	310	352
Oct. 12	637	550	385	406	92	442	437	395	(363)	387	459	344	352
Oct. 13	618	520	322	380	126	430	448	58	(479)	106	410	175	268
Oct. 14	630	556	301	179	77	411	453	88	313	107	400	374	323
Means	614	516	374	366	232	445	417	299	416	297	346	239	300
Departures	+45	+27	−7	−10	−58	+48	+47	−3	+4	-----	−16	−6	+16
Oct. 15	604	529	132	367	200	405	368	214	405	132	466	383	139
Oct. 16	305	260	58	286	318	406	436	135	452	272	356	-----	390
Oct. 17	466	453	85	206	368	425	422	119	364	193	356	254	166
Oct. 18	422	442	237	398	355	371	428	285	118	37	214	61	129
Oct. 19	578	522	411	418	360	421	424	261	377	127	394	87	127
Oct. 20	507	404	335	393	411	410	396	385	434	370	461	163	328
Oct. 21	582	502	378	414	148	406	393	342	443	342	138	168	290
Means	495	444	234	354	300	406	410	249	370	210	341	186	224
Departures	−37	−23	−88	+7	+5	+39	+53	−34	−18	-----	−13	−53	−40
Oct. 22	525	450	373	400	237	408	399	180	431	214	449	370	111
Oct. 23	552	494	366	-----	382	397	365	378	413	340	324	345	344
Oct. 24	471	512	370	402	167	397	374	194	(426)	233	410	352	209
Oct. 25	544	474	378	392	70	381	353	45	(423)	51	410	360	93
Oct. 26	538	513	367	352	361	368	236	302	294	218	405	347	201
Oct. 27	518	418	311	359	380	365	363	350	398	351	314	318	315
Oct. 28	510	384	349	367	67	355	369	87	370	236	387	326	254
Means	522	464	359	379	238	382	351	219	394	235	386	346	218
Departures	+27	+22	+54	+51	−10	+34	+21	−36	+58	-----	+50	+67	−7
ACCUMULATED DEPARTURES ON OCTOBER 28, 1949	+392	+455	−11,116	-----	+6,615	+10,955	-----	−1,792	+1,239	-----	-----	−882	-----

Date	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Lynn, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	East Lansing, Mich.	Madison, Wis.	Portland, Maine	Toronto, Canada	Caribou, Maine	Summit, Mont.	Fairbanks, Alaska
1949																	
Oct. 1	449	316	470	454	449	499	472	466	446	448	352	429	475	402	456	133	159
Oct. 2	424	290	477	447	381	412	466	415	437	394	335	404	462	376	433	207	86
Oct. 3	422	434	472	118	444	473	437	406	386	418	57	133	420	106	325	289	95
Oct. 4	155	115	360	204	322	287	282	270	161	399	95	342	366	136	177	276	52
Oct. 5	305	228	201	420	179	218	212	212	278	159	311	318	252	400	213	114	70
Oct. 6	145	223	427	107	424	431	392	396	167	232	42	30	418	142	424	106	109
Oct. 7	149	353	230	414	365	333	303	302	79	73	279	331	374	119	416	218	72
Means	293	266	377	309	366	379	366	352	279	303	210	284	395	240	350	192	92
Departures	+12	−61	+64	−21	+55	+65	+76	-----	−6	−49	−44	−1	-----	−26	----	−38	−21
Oct. 8	315	379	124	390	69	145	121	134	297	150	310	292	144	339	89	418	53
Oct. 9	348	125	137	380	104	116	130	112	348	350	261	341	96	313	197	99	54
Oct. 10	387	391	358	387	354	341	358	341	324	408	320	168	340	307	383	111	59
Oct. 11	382	264	344	279	268	236	213	176	377	369	60	311	113	147	325	79	91
Oct. 12	298	433	240	325	304	392	380	344	215	356	348	392	377	122	276	(180)	67
Oct. 13	429	405	327	387	348	384	393	112	416	398	338	376	396	333	385	(280)	76
Oct. 14	133	180	405	295	393	410	354	132	380	394	248	225	379	255	337	244	46
Means	328	311	276	349	263	289	278	193	336	346	269	301	264	259	285	202	64
Departures	+71	+2	−31	+73	−16	−19	+47	-----	+55	+6	+49	+41	-----	+42	----	+17	−24
Oct. 15	165	399	134	338	90	117	114	113	223	376	323	377	78	342	121	52	----
Oct. 16	395	378	407	383	355	413	402	377	-----	376	316	354	388	349	363	226	----
Oct. 17	244	369	368	324	329	356	333	325	292	283	224	310	366	196	354	91	77
Oct. 18	297	222	186	338	299	244	235	252	253	247	252	283	302	126	302	95	106
Oct. 19	242	194	294	353	274	358	313	352	-----	108	286	112	326	301	313	146	61
Oct. 20	369	41	322	286	326	330	364	323	356	122	234	95	324	231	274	136	83
Oct. 21	315	209	348	96	345	346	368	293	150	357	51	83	315	99	101	266	45
Means	290	259	294	302	288	309	304	277	255	267	241	231	300	235	261	144	74
Departures	+48	−36	+11	+49	+29	+27	+57	-----	+9	−41	+31	−3	-----	+20	----	−17	+1
Oct. 22	184	383	155	352	166	82	------	64	163	347	252	346	55	212	39	(257)	115
Oct. 23	365	364	352	345	365	354	------	327	265	331	158	357	313	111	105	197	110
Oct. 24	184	359	197	353	145	67	63	491	161	344	253	348	93	194	235	(89)	98
Oct. 25	36	295	202	342	184	220	293	276	103	319	263	101	313	208	335	(245)	42
Oct. 26	271	339	134	356	145	139	145	140	167	270	300	343	146	159	19	220	52
Oct. 27	355	277	359	362	339	362	337	331	318	306	280	312	334	277	250	45	27
Oct. 28	199	263	300	301	317	331	317	280	264	256	257	275	313	242	141	(25)	19
Means	228	326	243	344	237	222	231	273	206	310	252	297	224	200	161	154	66
Departures	+12	+47	+17	+102	+31	+7	+45	-----	+32	+32	+62	+83	-----	+18	----	+8	+8
ACCUMULATED DEPARTURES ON OCTOBER 28, 1949	+8,022	−3,801	+6,440	+10,528	+3,952	+7,001	+11,830	-----	-----	+3,892	−3,577	+9,366	-----	+329	----	+434	----

NOTE.—Values in parentheses are interpolated.

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground as received on a vertical surface facing south at Blue Hill, Mass., during October 1949*

Date	1	2	3	4	5	6	7	Mean	8	9	10	11	12	13	14	Mean	15	16	17	18	19	20	21	Mean
Gm cal cm^{-2}	507	432	494	255	194	462	318	380	97	66	394	245	453	460	517	319	74	542	428	237	439	420	476	374
Date	22	23	24	25	26	27	28	Mean																
Gm cal cm^{-2}	42	501	39	224	134	551	490	283																

TABLE 4.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground as received on a vertical surface facing north at Blue Hill, Mass., during October 1949*

Date	1	2	3	4	5	6	7	Mean	8	9	10	11	12	13	14	Mean	15	16	17	18	19	20	21	Mean
Gm cal cm^{-2}	54	61	55	74	54	58	59	59	53	51	54	58	51	52	52	53	43	54	62	72	65	53	46	56
Date	22	23	24	25	26	27	28	Mean																
Gm cal cm^{-2}	39	45	23	50	44	47	50	42																

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Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, October 1949

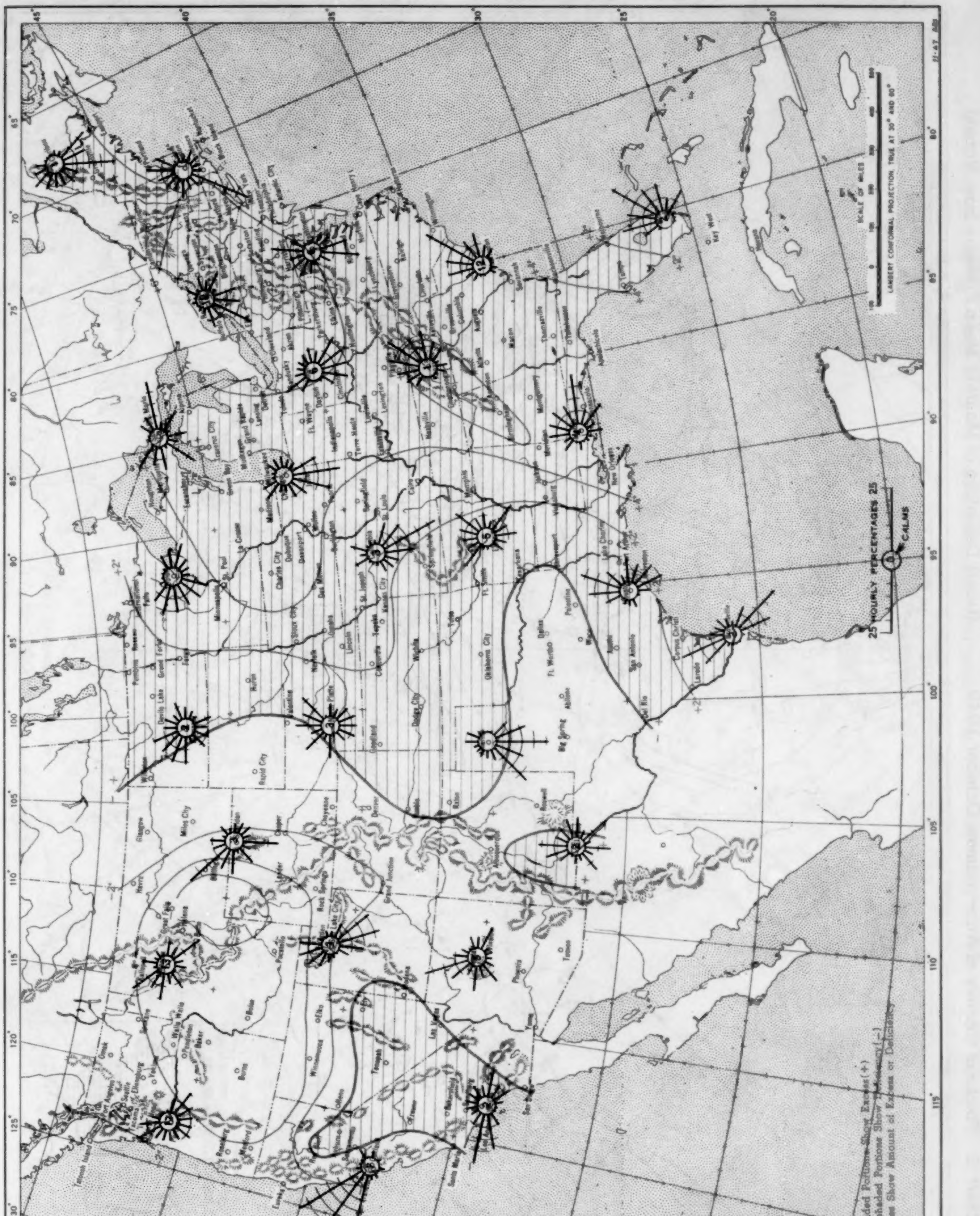
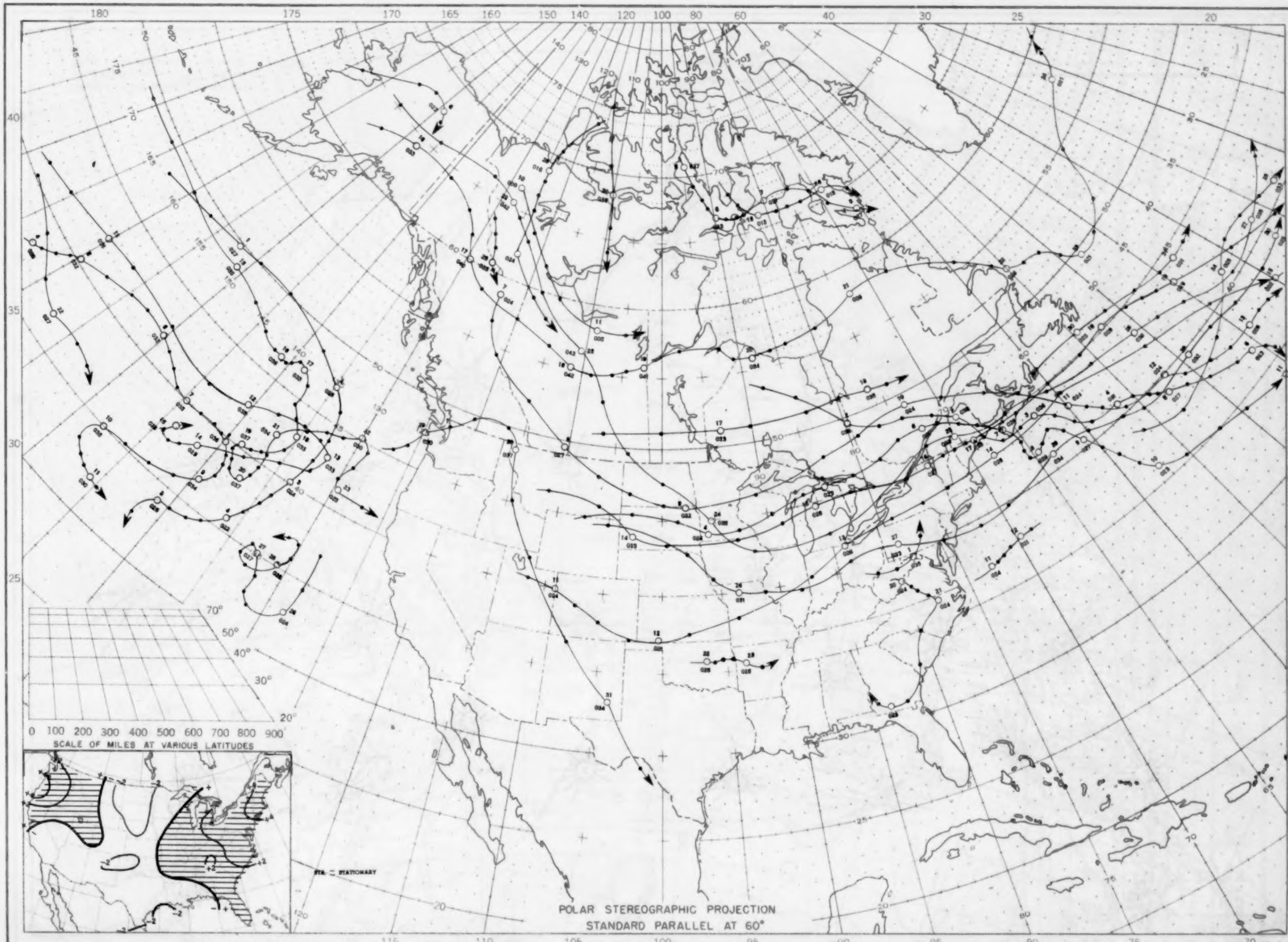
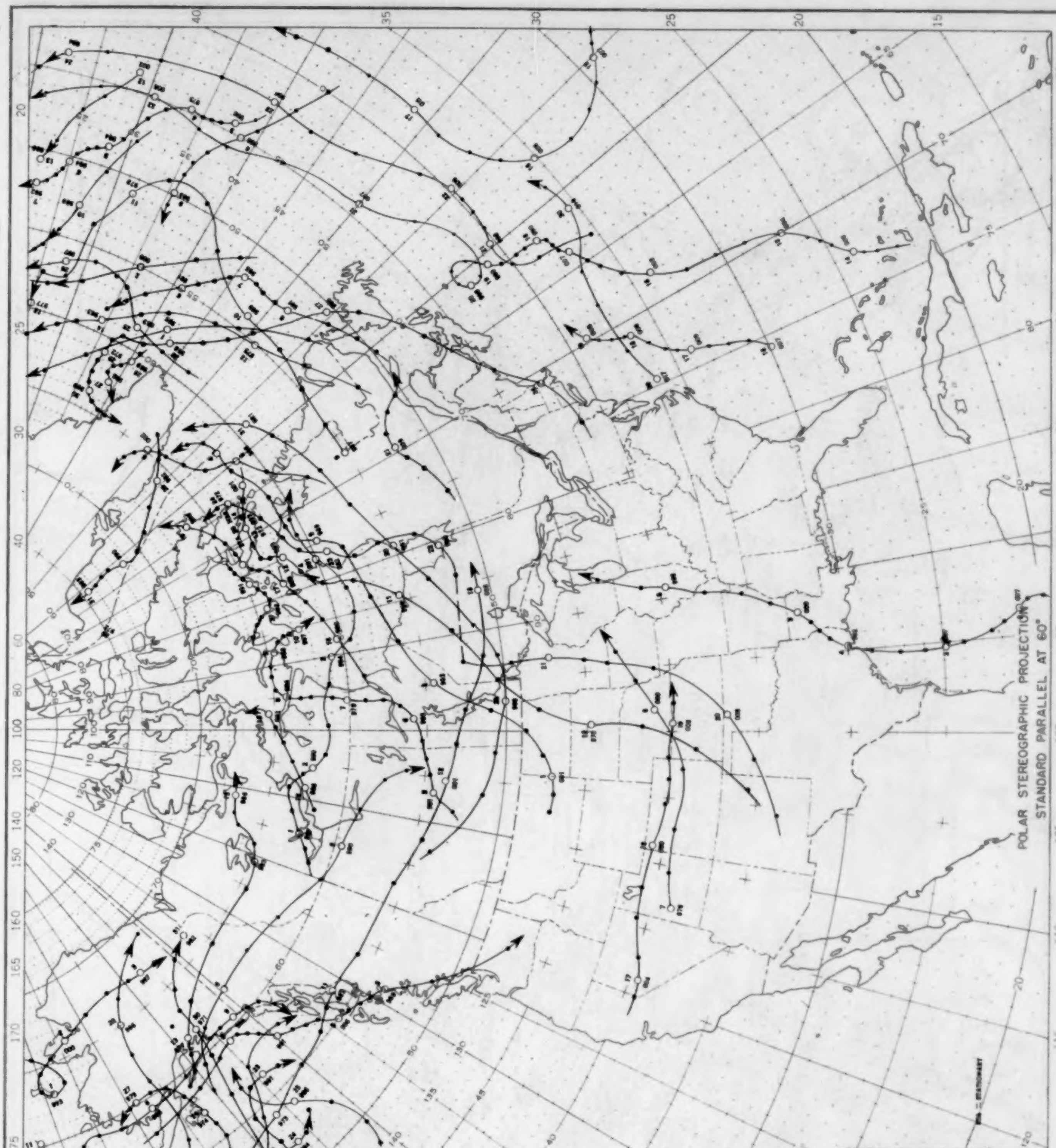


Chart II. Tracks of Centers of Anticyclones, October 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, October 1949. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, October 1949

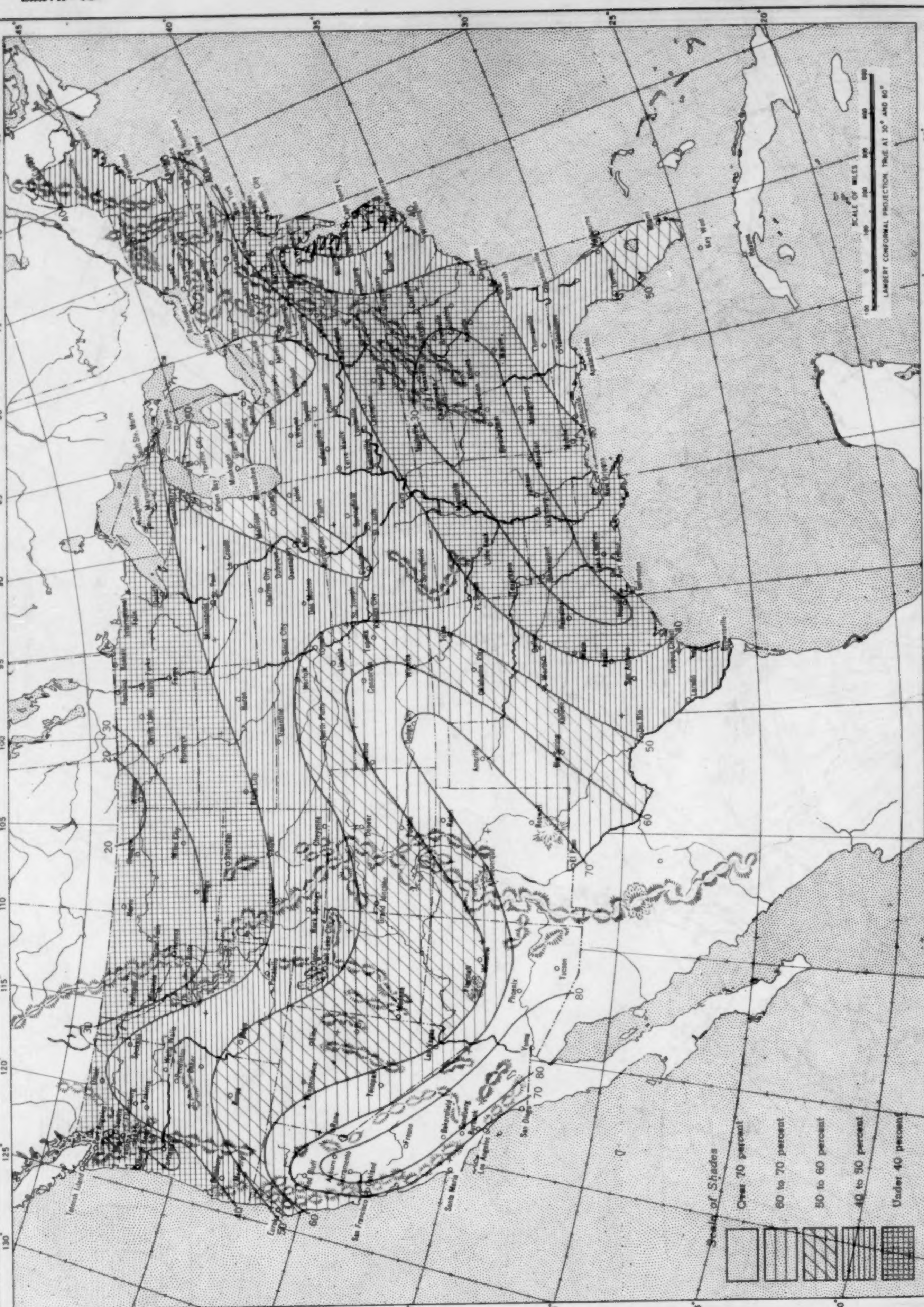
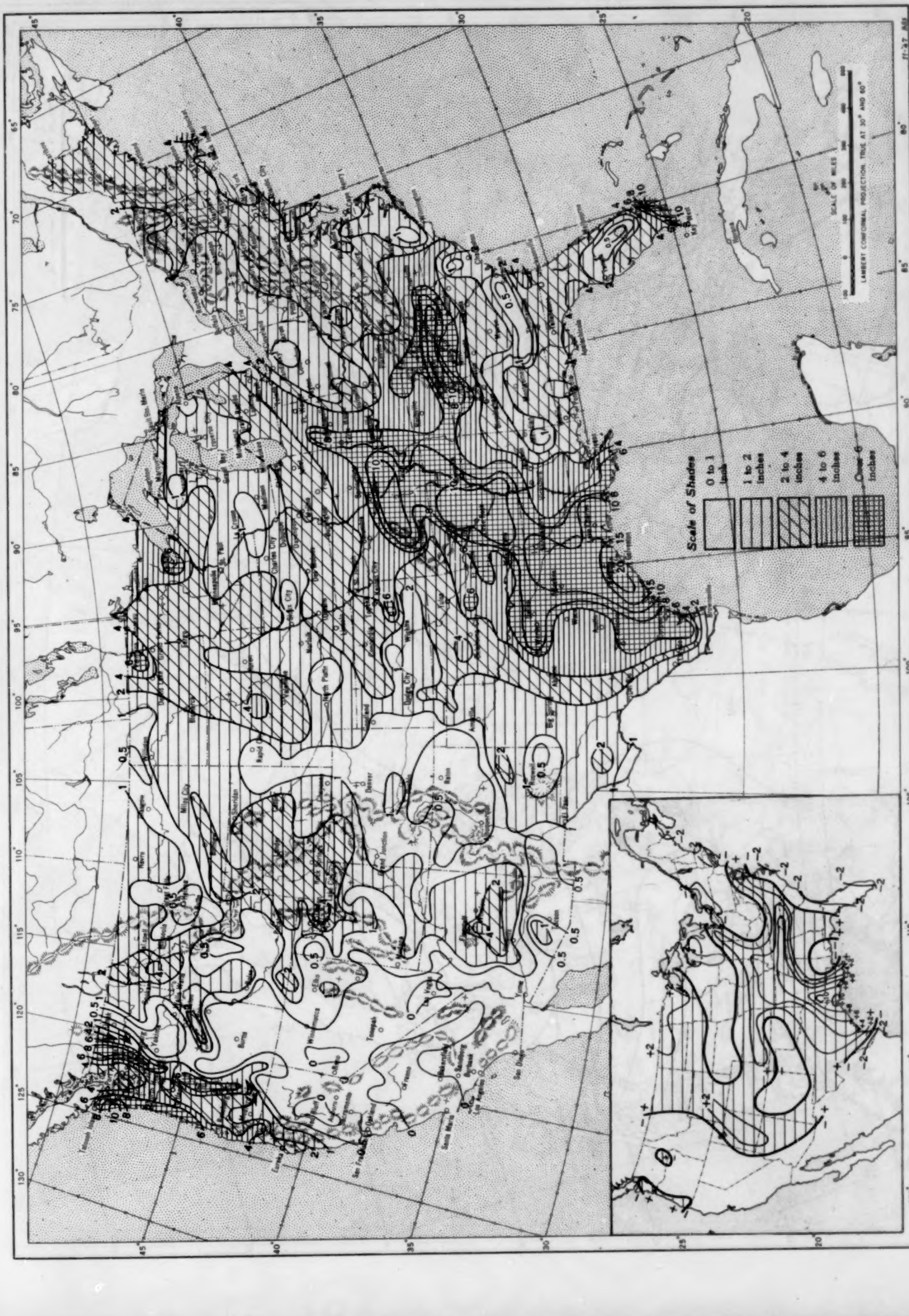


Chart V. Total Precipitation, Inches, October 1949. (Inset) Departure of Precipitation from Normal



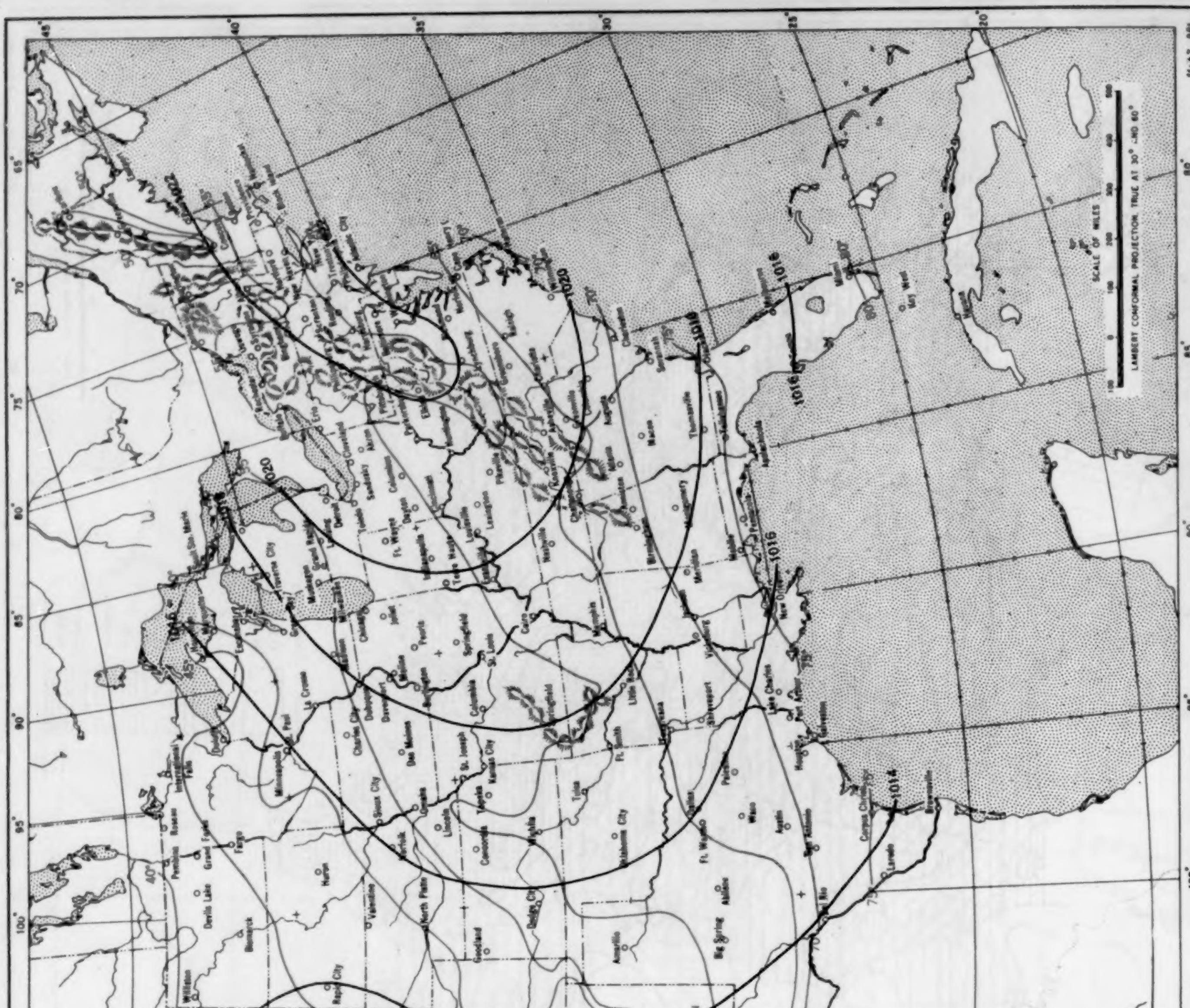
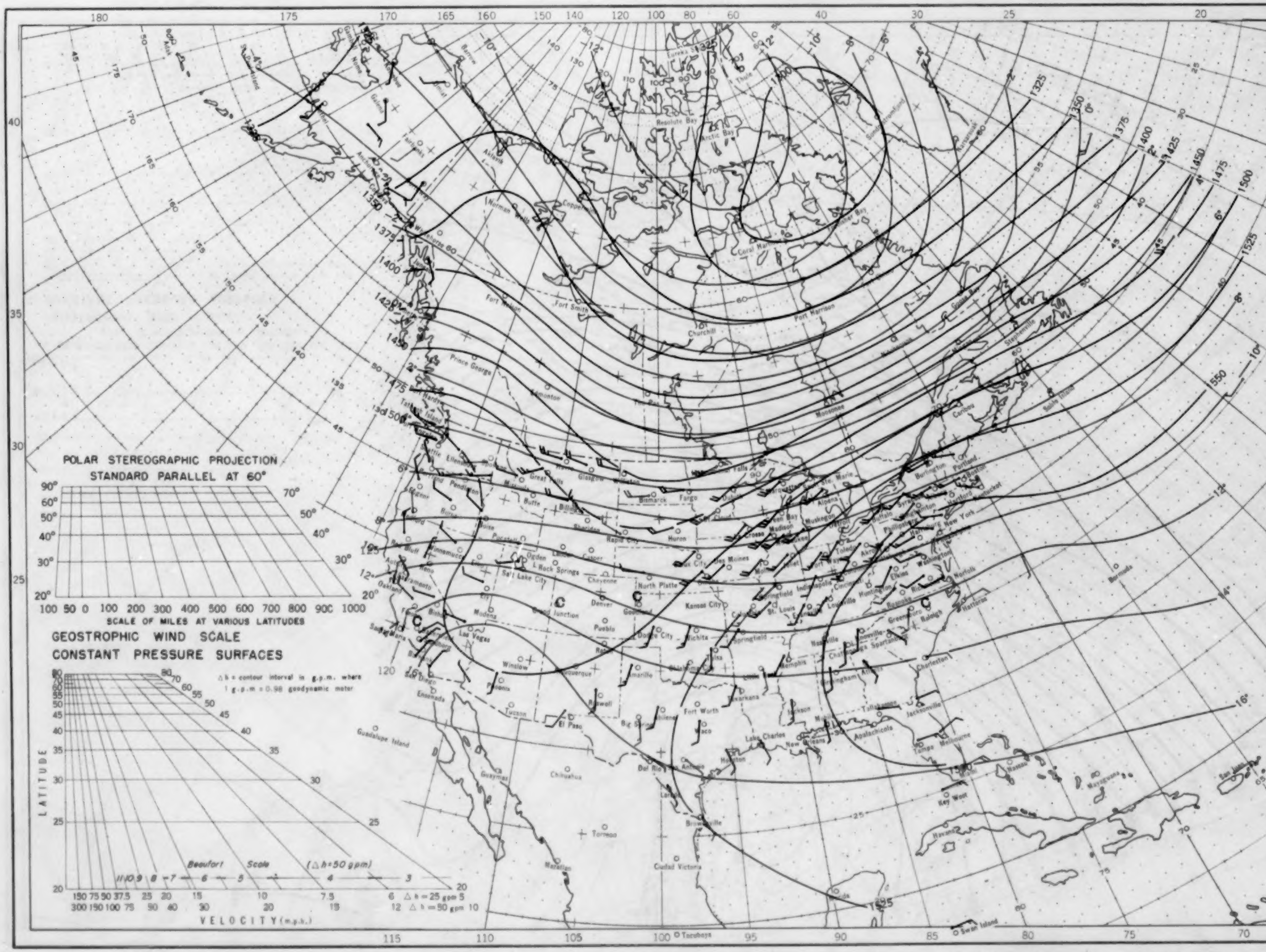


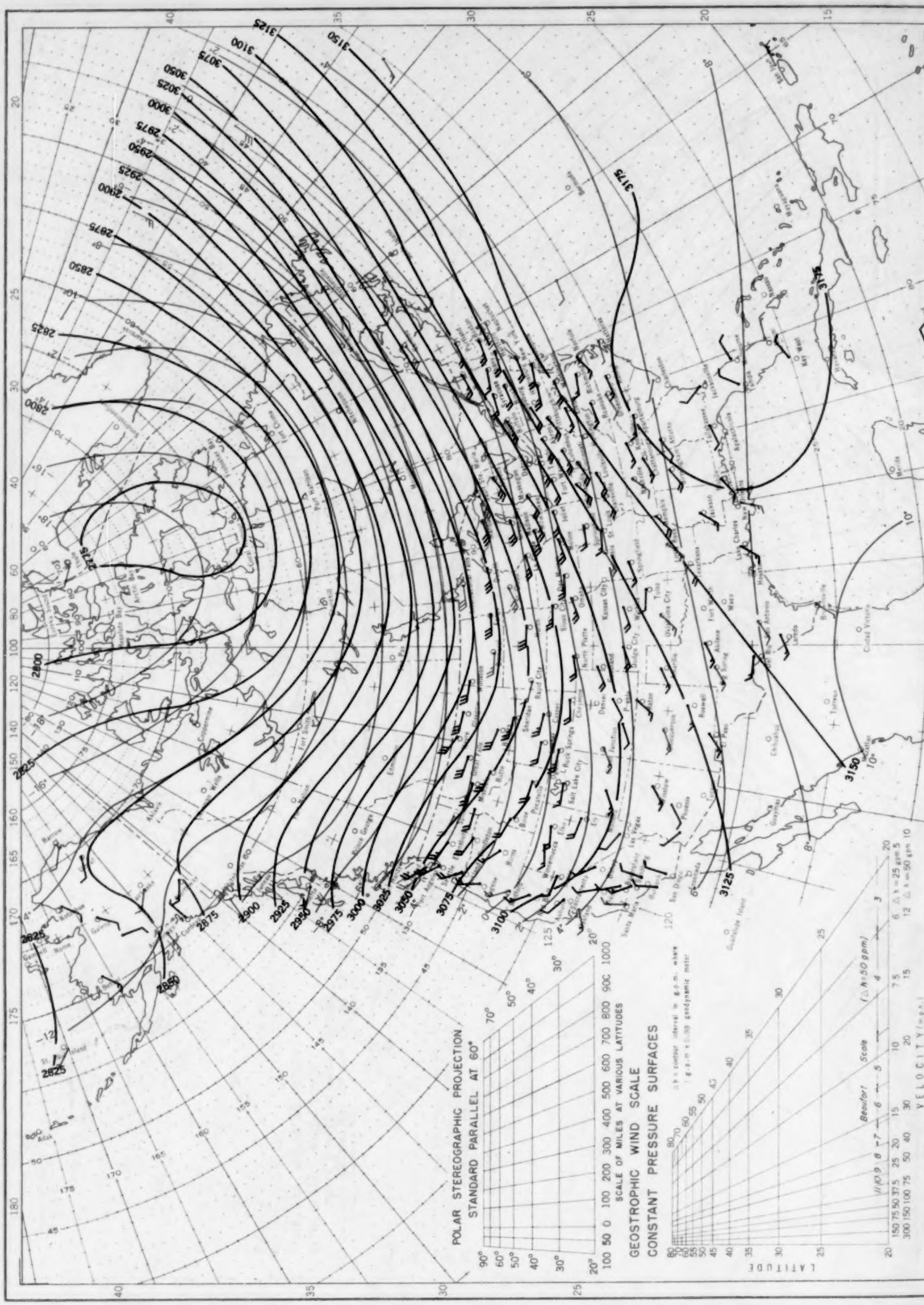
Chart VI. Mean Isobars (mb.) at Sea Level and Mean Isotherms (°F.) at Surface., October 1949

Chart VIII, October 1949. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



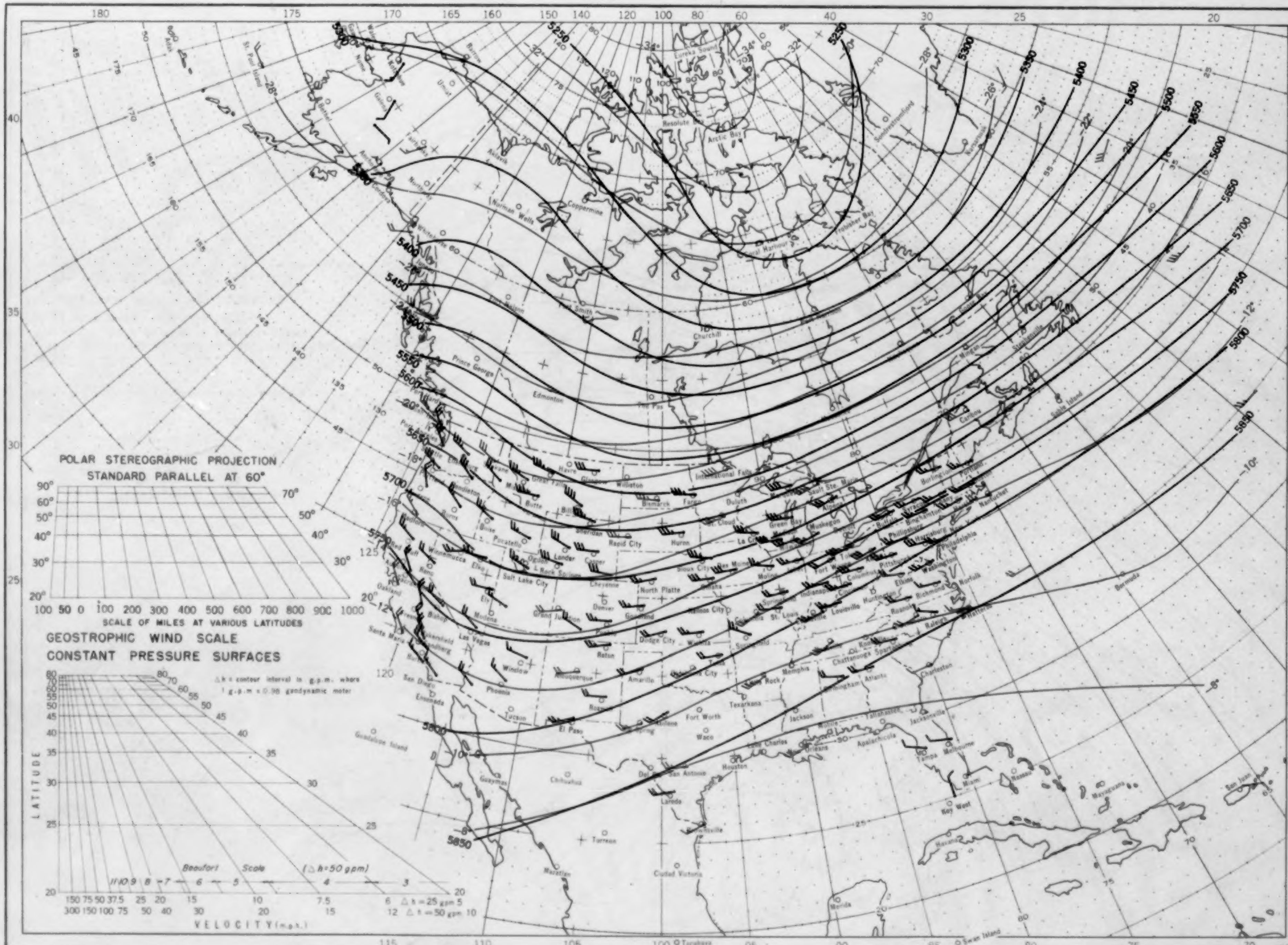
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart IX, October 1949. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



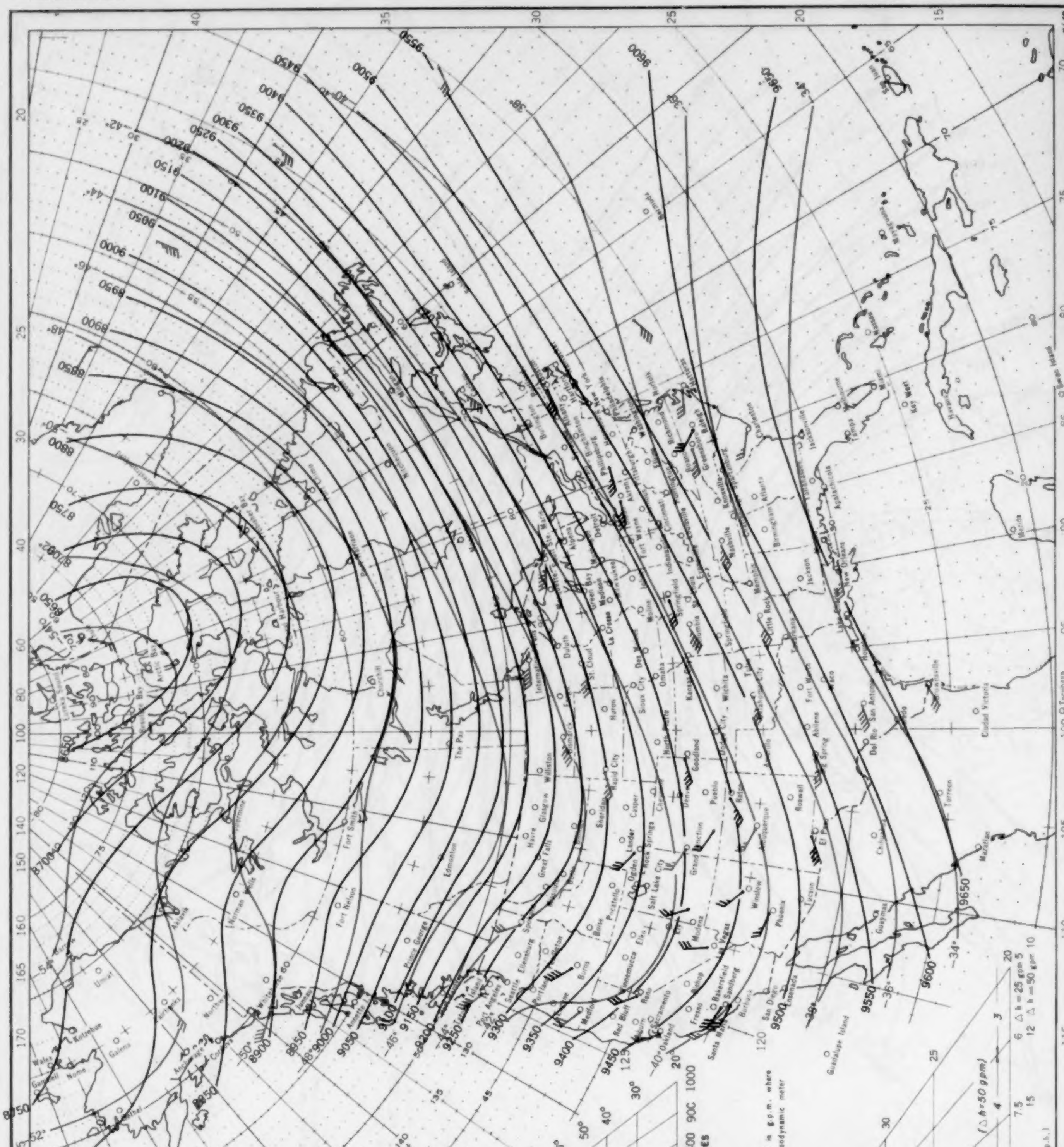
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, October 1949. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, October 1949. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.